PUBLIC WORKS

Apr.
1958

CITY, COUNTY AND STATE

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Bring Added Revenue
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AND MANY OTHER
IMPORTANT ARTICLES
SEE PAGE 5

Henry J. Graeser is Superintendent of the Dallas City Water Works, his duties including direction of the sewerage system and sewage treatment plant besides water supply, treatment and distribution. More on page 18.

Most economical chlorinator for smaller water works, sewage plants. Safe, accurate, corrosion-resistant. Manual or semi-automatic. Capacities to 100 ppd.

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Single well to major treatment works . . . the chlorinator *you* need is a Fischer & Porter Chlorinator. F & P developments have been incorporated in chlorinators covering the widest range of treatment requirements . . . from a fraction of a pound to 8000 pounds of chlorine per day.

Whichever F & P Chlorinator suits your needs best, you'll find it the most up to date unit available. For it's made by the same F & P engineers who have been responsible for every major improvement in chlorinator design in the past five years. This same group brought the corrosion-proof, diaphragm regulator, flowmeter type chlorinator to reality.

* * *

If you'd like to share in the benefits of advanced F & P chlorinator design, write now for complete details . . . and a list of installations. Visit any one of these and you'll see why so many users have found everything they were looking for in a Fischer & Porter Chlorinator. Write Fischer & Porter Company, 548 Fischer Rd., Hatboro, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane Street, Toronto, Ontario.

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Designed By Stevens and Thompson, Architects-Engineers

14 trucks bring garbage to Winston-Salem's fifth sanitary landfill where CAT No. 977 Traxcavator scoops up refuse and compacts it firmly. This landfill serves 10 sq. mi. of Winston-Salem.

Fast-moving Traxcavator digs out earth to cover garbage, then spreads and compacts dirt. Refuse is covered every night with 4 to 6 in. of soil, then topped with 2-ft. cover. Area shown will soon be new airport runway.

In Winston-Salem, sanitary landfill saves money and reclaims 5 different sites...*so far*

"Our budget is now less to operate two landfills than for an incinerator. And our Traxcavator is ideal for every landfill operation—digging, covering and compacting."—Director of Public Works

In-seat starting. All levers within easy reach. Bucket control is one-hand operation.
Operator sits high with excellent view of entire job.
3 sizes: 1, 1½, 2¼ yd. buckets. New side dump bucket available, too.
Bucket tips back 40° at ground level; better leverage for digging; less spillage.

Competitive demonstration sold this Caterpillar No. 977 Traxcavator

Of 3 bids, Caterpillar's was high. But city officials wanted to see all 3 makes of machines in action, on an actual city job. There they saw what they couldn't see on paper — the superior agility and higher production of the Traxcavator. They knew that Cat-built machines are recognized for longer life, with less maintenance, which means lowest *final cost*. A demonstration on your job can prove all this. All it takes is a phone call to your Caterpillar Dealer.

When Winston-Salem adopted a modern sanitary landfill method of garbage disposal, the city found it could use its old incinerator area as an athletic field. That was just the first of five—so far—sites put to use as a result of sanitary landfill.

No. 2 was a school playground that used to flood with every rain. Now, it's high and dry. No. 3 is the city's own equipment storage yard, reclaimed from an unused low area. No. 4 will soon be a 1,200-car parking lot at Bowman Grey Stadium. Now No. 5 is on the way: a runway extension at Smith-Reynolds Airport.

Not only does the city benefit from this reclamation, but "landfill is definitely more economical than an incinerator," according to R. W. Neilson, Director of Public Works. "We keep two landfills going for less than the cost of our incinerator."

Would you like complete information about sanitary landfill? Just write Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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BPA

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APRIL 1958

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THE MOST USEFUL ENGINEERING MAGAZINE FOR CITIES, COUNTIES AND STATES

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A single, molded rubber gasket is the only accessory required. There are no bolts, no nuts, no followers, no couplings, no extras.

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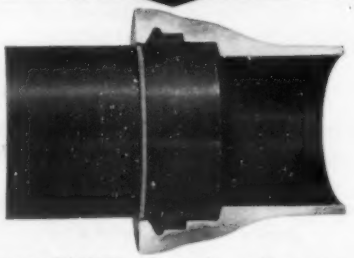
Available in any specified thickness or weight class in accordance with ASA, AWWA or Federal specifications. 3" to 24".



CLOW Bell-Tite Joint is easily assembled—Just wipe clean, lubricate and push spigot into the bell. When painted yellow stripe is no longer visible, joint is bottle tight.

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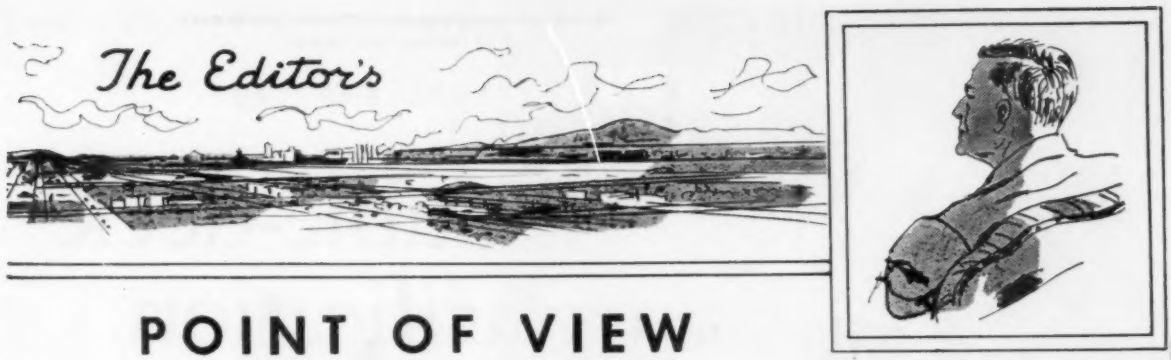


POINT OF VIEW

Public Relations vs the Forward Look in the Water Works Industry

MUCH STRESS has been placed recently on public relations in water departments, and rightly so. Better public relations are needed by many water utilities and by other public works agencies, too, whether their function is street work, sewerage, refuse or other.

But we must never forget that public relations can not take the place of sound planning, based on good technical knowledge; nor the place of actual accomplishment. Public relations may help in soothing the citizen who cannot get enough water, or who gets unsatisfactory water; but the job of the water manager is to see that the citizen gets enough water and good water.

It would seem strange to have the electric company tell us we could burn only one light winter nights; the gas company restrict us to one burner on the gas stove; or the telephone company let us make calls only on the even days of the month if we live on the even-numbered side of the street.

We need public relations but we also need the forward look.

The Problem of Increasing Automobile Size

SOME TIME ago we commented on automobile overhang and the need for driveway designs to fit these modern cars. Driveways, of course, are not the only thing to feel the impact of greater length. Parking meters are having to be moved, parking spaces are reduced in number and private and public garages no longer have the car capacity for which they were designed.

So long as lots of people want longer, and wider, cars, that is the way automobiles will be built. There is probably little the engineer can do about it, unless he can devise a quick and easy way to move parking meters. But he can keep flexibly minded, even if most of his work is in inflexible steel and concrete.

It Was a Rough Winter and Maintenance Work Is Needed

THE PAST winter was a rough one. In the north it brought unusual snowfalls and subzero weather; in the south it brought freezing temperatures and snows, also, though not to the same crippling extent. To cap it all, there have been fairly hard rains with some flooding.

Street and highway damage in the north has been severe, with an unusual mileage of broken roads and much pothole formation. Before the men are rested from the long siege of snow-plowing and the equipment brought back to good condition, maintenance work will be very pressing indeed. The state, city or county with a well organized and properly equipped maintenance team will be fortunate.

The growing task of maintenance cannot be overlooked. Not only is it necessary to conserve our investment in the streets and highways we live by, but it is equally necessary to permit safe and uninterrupted travel. There can be no substitute for modern maintenance equipment, operated by well trained and properly directed men. In fact no state, no county and no city can afford not to have these essential items for upon their prompt and proper use depends our highway investment and our day-to-day operations.

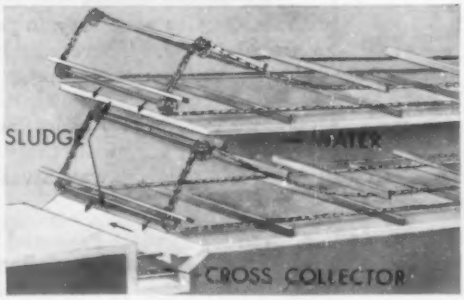
A Broader Market Proposed for Sale of State and Local Bonds

LEGISLATION WHICH will assist state and local governments in finding a market for the rapidly increasing volume of new bond issues is pending before the House Ways and Means Committee. This legislation, known as HR 8702, has bipartisan sponsorship in the Ways and Means Committee. HR 8702 would make the bonds of state and local governments attractive to investment companies and thereby materially broaden the market. At the present time these companies are kept out of the municipal market by the barrier in the law which converts tax-free interest into fully taxable dividends when distributed to the shareholders of investment companies. By allowing these companies to pass the interest to the beneficial owners, the enactment of this legislation would remove the barrier and enable state and local governments to tap these vast pools of funds. This bill would cost the Federal government very little loss of revenue since the bonds must be issued if the badly needed public improvements are to be made, and the interest will be exempt to whoever holds them.

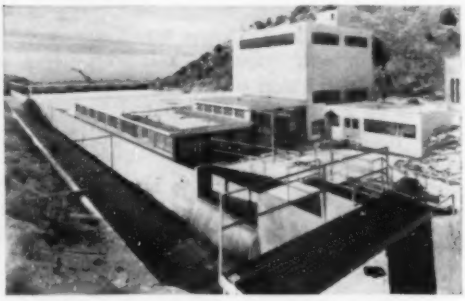
Hearings have already been held on the principle of the pass-through and the Ways and Means Committee is expected to vote upon the proposal very soon. All of those interested in reducing the cost of borrowed money to state and local governments should communicate their support of HR 8702 at once to their own Congressman as well as to the members of the Ways and Means Committee.

● *See our exhibit at the A.W.W.A. Conference in Dallas, April 20-25*

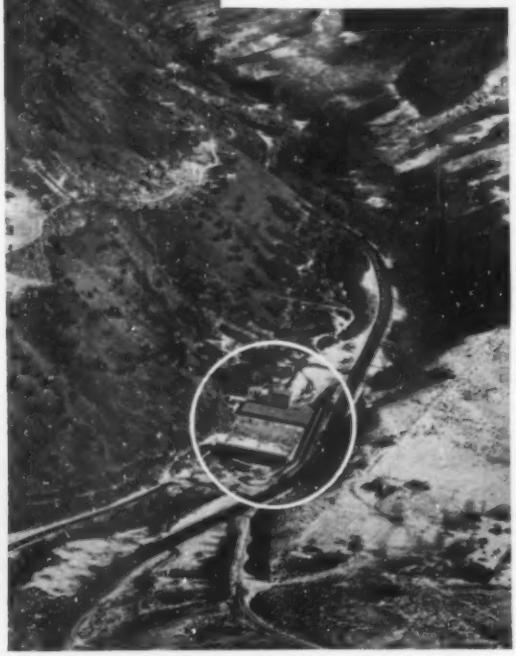
Double-deck clarification plant! *LINK-BELT equipment at Salt Lake City cleans 32 million gpd*



TWO-STORY TREATMENT. Diagram shows one of eight double-deck settling tanks equipped with Link-Belt sludge collectors each over 300 feet long. Flocculation chambers are also Link-Belt.



INTAKE WATER is received from adjacent hydro-electric plant or by-pass canal. Leaves, sticks and other large debris are removed by a pair of Link-Belt traveling water screens.



SALT Lake City's water supply comes from mountains east of the city, carrying with it—during flash storms or fast thaws—solids amounting to as much as 60 ppm.

Called on for facilities to remove solids and purify the water, the consulting engineers were presented two unusual challenges. Topography made compactness essential—and settling tanks had to be protected from freeze-up. Both were overcome by *Double Deck enclosed* tanks, equipped with Link-Belt longitudinal sludge collectors. With this system, the Big Cottonwood plant has reduced solids to 3 ppm.

Just as Link-Belt cooperated with Consultant John A. Carollo and Co., Phoenix, Ariz., we invite the opportunity of working with you, your chemists and consultants to produce top efficiency in water, sewage or waste treatment. Call your nearest Link-Belt office.

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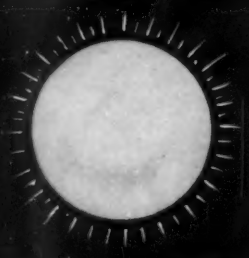

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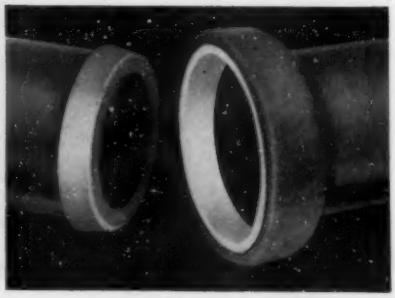

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Such pioneer cities as Ann Arbor, Michigan, Dayton, Ohio, Camden, New Jersey have installed their second and third Amvit sanitary lines.

A mechanical joint designed for quick, low-cost installation, Amvit* will give you lower cost-in-place. Here's how:

1. QUICK INSTALLATION SAVES LABOR

No other materials such as caulking, joint compound, hot pots, or ladles are needed to make the Amvit joint. The joint is on the pipe delivered to the job ready for use. Just push the pipe together and the joint is complete.

2. IMMEDIATE BACKFILLING

You can backfill as soon as the line is completed. Barricades can be removed and streets opened days sooner.

3. QUICK TESTING

No need to wait days to see if a line has passed test. A look at the completed joint will tell. Thus, engineers can inspect and accept the line allowing the contractor to receive payment quicker.

4. CONTROLS INFILTRATION

Field tests from completed installations show that infiltration can be definitely controlled. Engineers can, thus, reduce infiltration specifications, use smaller diameter pipe and save in material cost.

5. ROOT PROOF

Amvit is a compression joint on the ball and socket principle. The surfaces of both bell and spigot are in uniform compression preventing root penetration.

6. BETTER FLOW, LESS MAINTENANCE

The design of the joint assures that the pipe is self-centered at all times. This gives perfect alignment and self-cleansing. Because the joint is really tight, no foreign matter such as dirt, sand and stones can possibly enter the line.

7. COMPLETE FITTINGS

Amvit is furnished on all standard fittings, as well as pipe. This will permit a uniformly tight line from house wall to treatment plant.

Amvit Jointed Clay Pipe, in sizes 4" through 24" together with all fittings is available for immediate delivery in the Northeast and Central States.

For more information on how Amvit can help cut your sewer project costs, write or call American Vitrified Products Company, National City Bank Building, Cleveland, Ohio, or our office nearest you.

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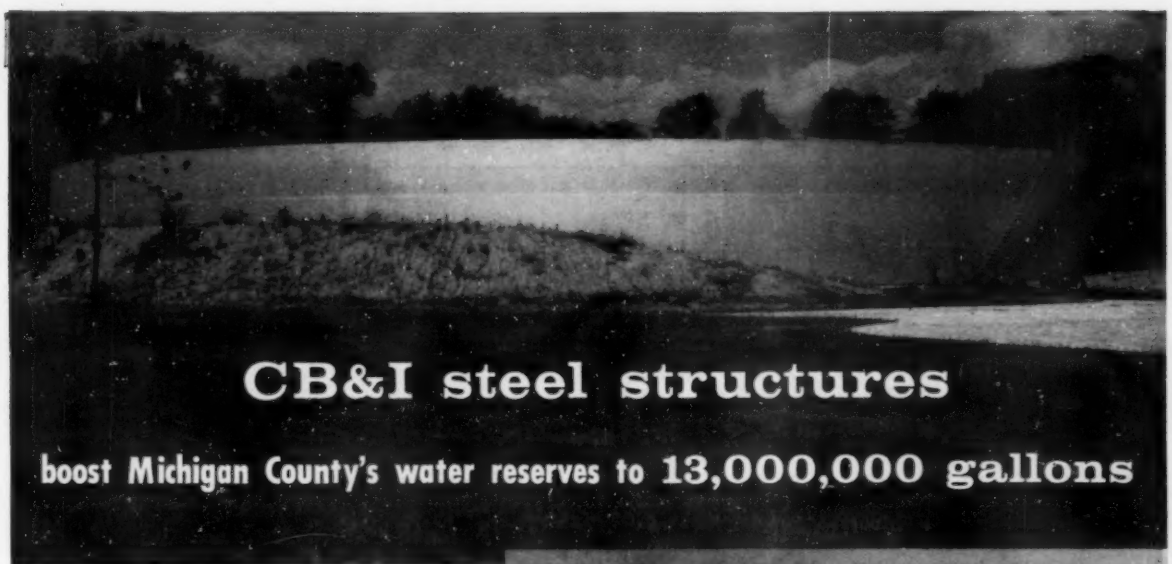


CB&I steel structures

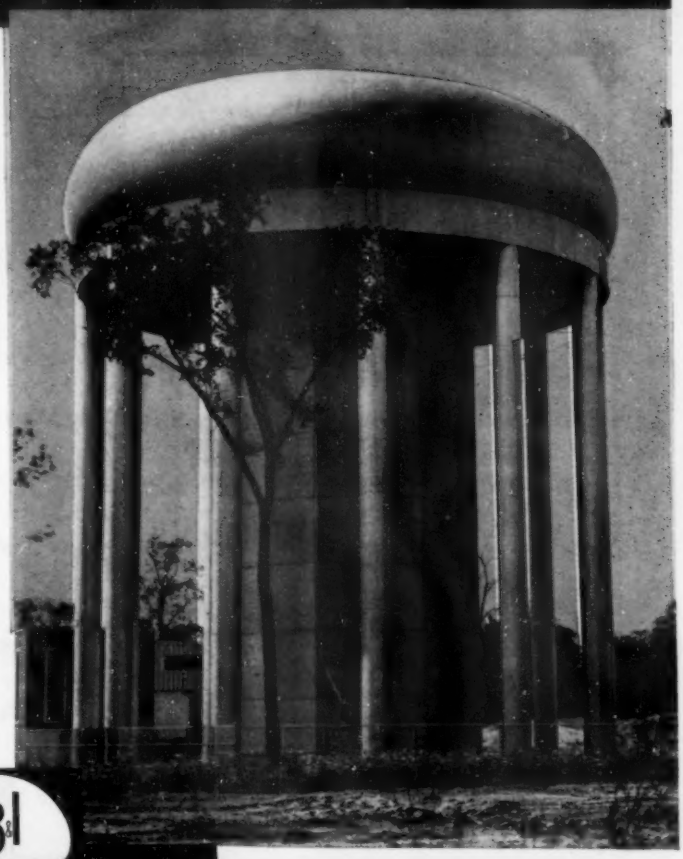
boost Michigan County's water reserves to 13,000,000 gallons

These two CB&I-built, all welded, structures share the responsibility with two 1,000,000-gallon Horton® radial-cone elevated tanks for providing Southeastern Oakland (Michigan) County with 13,000,000 gallons of dependable water storage.

In Oakland County, as in water-wise municipalities all over the country, CB&I water storage structures have already become an *integral part* of water commission or water department planning for increasing water needs.

Whether you require as little as 50,000 or 10,000,000 gallons or more of storage, you too can rely on CB&I's 67 years of *craftsmanship in steel* . . . to provide *your* community with assurance of *proven* engineering, fabricating, erection and trouble-free service life. In tanks and towers, as in any municipal service—it's proof of past performance that counts. And . . .

YOU CAN BE *SURE* WITH STEEL
. . . AND *CERTAIN* WITH CB&I



top: Horton cone-roof reservoir meets increased water needs of Southeastern Oakland (Michigan) County with 10,000,000-gallon water storage capacity.

bottom: Graceful Hortonspheroidal® tank minimizes pressure variations and meets peak load demands with gravity flow from 1,000,000-gallon elevated reserve.

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Why choose between high flow, strength and long life when cast iron pipe gives you *all* of them?

Specify America's #1 pipe and your water system will serve long after the bond issue is retired.

*Here is the proof!

FLOW FACTORS FOR CEMENT LINED CAST IRON PIPE

LOCATION	SIZE	TEST SECT. IN FEET	VELOCITY F.P.S.	AGE YEARS	W & H "C" FACTOR
Bowling Green, Ohio	20"	45,592	0.7-2.4	New	142.5
Chicago, Illinois	36"	7,200	2.6-3.6	New	147
New Orleans, La.	12"	39,650	1.2-2.9	New	141
Corder, Mo.	8"	21,350	0.9-2.3	New	143
Univ. of Illinois	8"	400	3.14	New	150
Concord, New Hamp.	14"	500	1.7-2.2	New	151
Concord, New Hamp.	12"	500	2.0-3.4	11	142
West Palm Beach, Fla.	12"	500	3.6-5.4	15	139.5
Greenville, S. C.	30"	87,376	2.4-2.7	12	148.5
Corpus Christi, Tex.	30"	65,641	1.1-1.8	6	146
Summerville, S. C.	8"	500	1.98-2.43	13	142.5
Champaign, Illinois	16"	3,920	3.1-5.6	22	139.3

*Available upon request: Booklet containing flow test and tables on Cast Iron Pipe.

pipe FOR MODERN WATER WORKS

NEW SIMPLEX ELECTRO-PNEUMATIC SYSTEM PROGRAMS FILTER WASHING AUTOMATICALLY

Fully-interlocked System Regulates Flow; Shuts Down, Washes, Rinses, and Reopens Filters

Now simplicity, efficiency and manpower savings come to filter plants with the new Simplex Automated Filter Operating Table.

From one central point, filtering and washing cycles can be initiated automatically . . . all rates and times maintained accurately. Valve action is completely pneumatic! The system contains no electrical devices that might malfunction in the dampness of a wet pipe gallery.

Shut-off and Cut-off

This new system automatically shuts off a filter if the clearwell is filled—returns it to service when needed. Depending on the control you prefer, a filter will be automatically removed from service for backwashing when (1) loss of head reaches cut-off point you pre-set (usually 8') or (2) electric timer has run through the value you pre-set (80 to 120 hrs.). At any point, the operator can manually over-ride these automatic controls.

No-Flood Washing

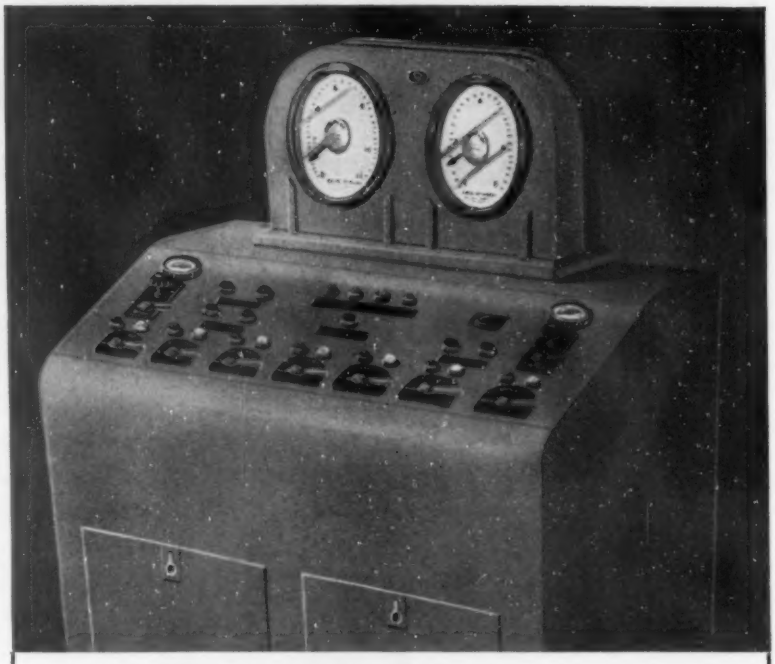
When automatic program starts, the filter Influent Valve is closed, water level drops to wash-trough lips, then the filter Effluent Valve is closed.

Next the Drain Valve is opened, followed by the Wash-Water Valve. Pneumatic interlocks prevent flooding: wash valve can't open until drain valve is fully open.

Washing is precisely timed at slow-fast-slow rates . . . so bed is cleaned and hydraulically graded for clean starts and optimum results.

Saves Treated Water

To prevent flooding, Drain Valve can't close until all Wash Valves have first closed. To prevent waste of treated water, filter Influent Valve can't open until drain valve has completely closed. Washing period can be extended, if desired.



NEW SIMPLEX AUTOMATED FILTER TABLE: Large dials indicate and/or record rate of flow and loss of head. Smaller dials set filtration and wash rates. Colored lights show progress of the automatic cycle. Manual levers permit operator to over-ride the automatic programming at any point.

Controlled Starts

To prevent turbid starts, when the Influent Valve is opened, the Effluent Valve stays closed until water reaches operating level. Float switch then opens Effluent Valve.

No Sequence Errors

Cascade programming makes mistakes impossible. All valves open and close in their proper sequence.

Automated Filter Plants

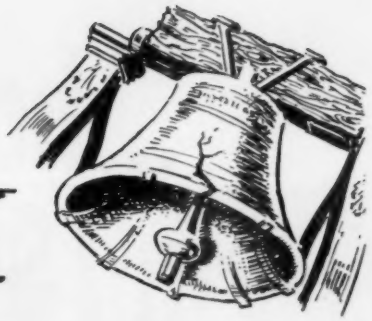
Obviously the control functions built into this new Simplex Table can also be used to control a series of filters. We'll gladly discuss your plans for integrated sequential control that interlinks all filters for fully automatic operation of an entire filter plant.

Your Plans

We'll gladly rush further details or a Bulletin to help you evaluate this important Simplex development. Write Simplex Valve & Meter Company, Dept. PW-4, 7 E. Orange Street, Lancaster, Pa.

SIMPLEX®
VALVE AND METER COMPANY

PHILADELPHIA, PA.*



chooses

TYLOX

RUBBER PIPE GASKETS

TO

- ***PREVENT INFILTRATION***
- ***WHIP DETERIORATION***
- ***REDUCE PIPE-LAYING COSTS***

* **PROJECT:** TYLOX-coupled Storm-Sanitary sewer for city of Philadelphia, Pa.

ENGINEERS: Dept. of Water, Philadelphia, Pa.

CONTRACTOR: Globe Contracting Co., Upper Darby, Pa.

PIPE: 72" Concrete culvert pipe—United States Concrete Pipe Co., 12" Vitrified Clay Pipe—Universal Sewer Pipe Corp.

For its new combination storm-sanitary sewer shown here under construction, the city wanted long-lasting, low maintenance lines—built within the budget. Engineers wanted leak-proof lines that would stay leak-proof. Contractors wanted fast pipe jointing to help offset high construction costs. Here's how the choice of Tylox Rubber Gaskets helped meet all three requirements efficiently and economically:

1—TYLOX Gaskets have **seven** sealing ribs that "pack" pipe joints tight by compression. Natural resilience of the rubber **keeps** the seal watertight. Sewage treatment costs are reduced, and root and sediment problems are prevented.

2—TYLOX Gaskets speed pipe laying through fast assembly, and by eliminating trench work delays . . . mud and water can't slow up work, and laid line may be backfilled immediately. Installation costs are reduced.

3—TYLOX Gaskets are made of rubber specially compounded for immunity to sewage and industrial waste acids. Under ground and under compression, TYLOX outlasts the pipe itself.

5087

Send for this brochure

It contains engineering data and shows typical TYLOX installations the world over. Read why TYLOX was specified, and take advantage of TYLOX on your next pipe project.

HAMILTON KENT MANUFACTURING COMPANY

KENT, OHIO

427 West Grant Street Orchard 3-9555

...how TD-9 4-in-1 Skid-Shovel

"runs" sanitary landfill.. "doubles" on street jobs

—for Montpelier, Vermont!

Montpelier put out its reeking, 56-year-old dump fire in July of '56—quickly eliminated a rat-reservation; a potential, disease-breeding vermin preserve; a perennially-unpopular and malodorous smog-and-smoke producer! Vermont's capital city (population 8,500) did this by starting a sanitary landfill on the old dump-site—with America's most popular refuse-disposal equipment: an International Drott Four-In-One Skid-Shovel. Their choice, the TD-9 Four-In-One, *takes less than four hours daily* to spread, compress, cover, and compact the every-day refuse delivery—an estimated 400 to 500 cu yd of loose garbage and rubbish.

Then the same operator takes the TD-9 Four-In-One into town—does street work the rest of the day—loads street base and surfacing materials; does clean-up jobs; digs, dozes, grades, back-fills, or spreads; helps wherever needed. Montpelier gets typical International Drott Four-In-One *versatility unlimited*—saves the need of owning a second crawler!

"We have found no limitations of TD-9 Four-In-One applications," reports Montpelier's City Engineer, John A. MacKensey. "It's the ideal machine for combined operations like ours."

Obtain cover dirt with surface-skimming action that "boils" in the earth like a carry-type scraper—using Four-In-One Bullclam position, under accurate clam lip control. Or dig cover dirt with powerful Four-In-One Skid-Shovel action.

Spread "cover" evenly on the go—regulate amount by controlling clam lip—with Four-In-One in Bullclam position. Then you can iron down the "cover" to make a positive odor-squelching seal —using compactor plate action, plus added pressure of full bucket!

To spread or spot-place refuse evenly, simply use Four-In-One as clamshell or bulldozer. You obtain any Four-In-One action *instantly* by a finger-tip flick of the machine selector lever!

To compress bulky refuse, apply compactor-plate ironing action—simply by rolling the lowered Four-In-One forward. You can also apply hydraulic down-pressure to really flatten cans and cartons!

Loading street-base material, obtained fast with exclusive triple-power pry-action break-out and 42° ground-level bucket roll-back. The TD-9 Four-In-One pays *double dividends* on every Montpelier tax dollar—*with dual-duty efficiency!*

Why not find out what an International Drott Four-In-One Skid-Shovel can do for your city? Compare cost-cutting Four-In-One versatility and capacity. Prove the machine-protecting, comfort-adding advantages of exclusive, shock-swallowing Hydro-Spring (standard equipment). See your International Drott distributor for a demonstration!

INTERNATIONAL HARVESTER

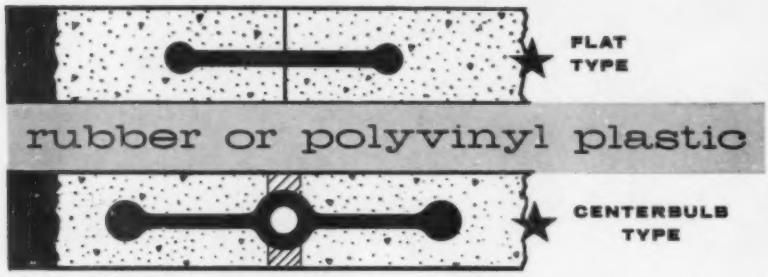
INTERNATIONAL®
DROTT®

SERVICISED

DUMBBELL DESIGN

WATERSTOP

for Watertight Concrete Joints

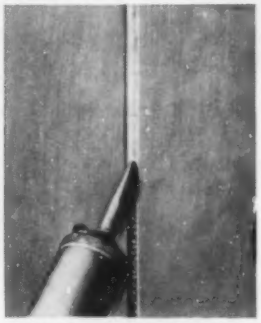


Servicised Dumbbell design has been used for more than 25 years in heavy concrete structures and where hydrostatic water pressure is present because it provides better retention of the waterstop in the joint during horizontal or vertical movement. When concrete contracts and the joint opens up, outer dumbbell edges become more tightly engaged with the concrete, making a tighter seal as the tension increases due to movement either in the joint or increasing water pressure on one side of the joint. Dumbbell design waterstop is made from rubber or polyvinyl plastic in both flat or centerbulb types. Write for special Catalog.

VERTISEAL

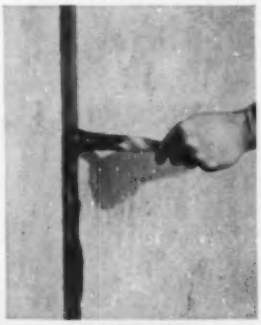
cold applied vertical joint sealer

★ Self-vulcanizing
★ No cold flow after cure
★ Maintains bond from below 0° to 150° F.
★ Black . . . White . . . Gray colors

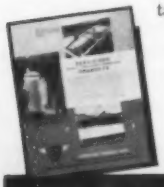


APPLIED WITH CAULKING GUN

Vertiseal is an extremely efficient joint sealing compound . . . resistant to petroleum derivatives, most common acids, fats and alkalis. Stable Composition, superior cohesive and adhesive qualities, and simple installation with caulking gun or by troweling, make Vertiseal first choice for sealing virtually any type of vertical or horizontal joints.



BY TROWELING



Write for special Vertiseal Catalog and Specifications.

SERVICISED PRODUCTS CORPORATION
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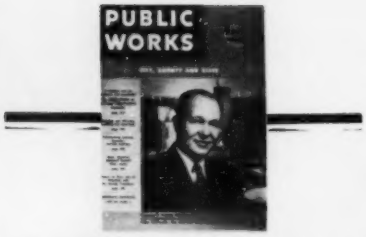


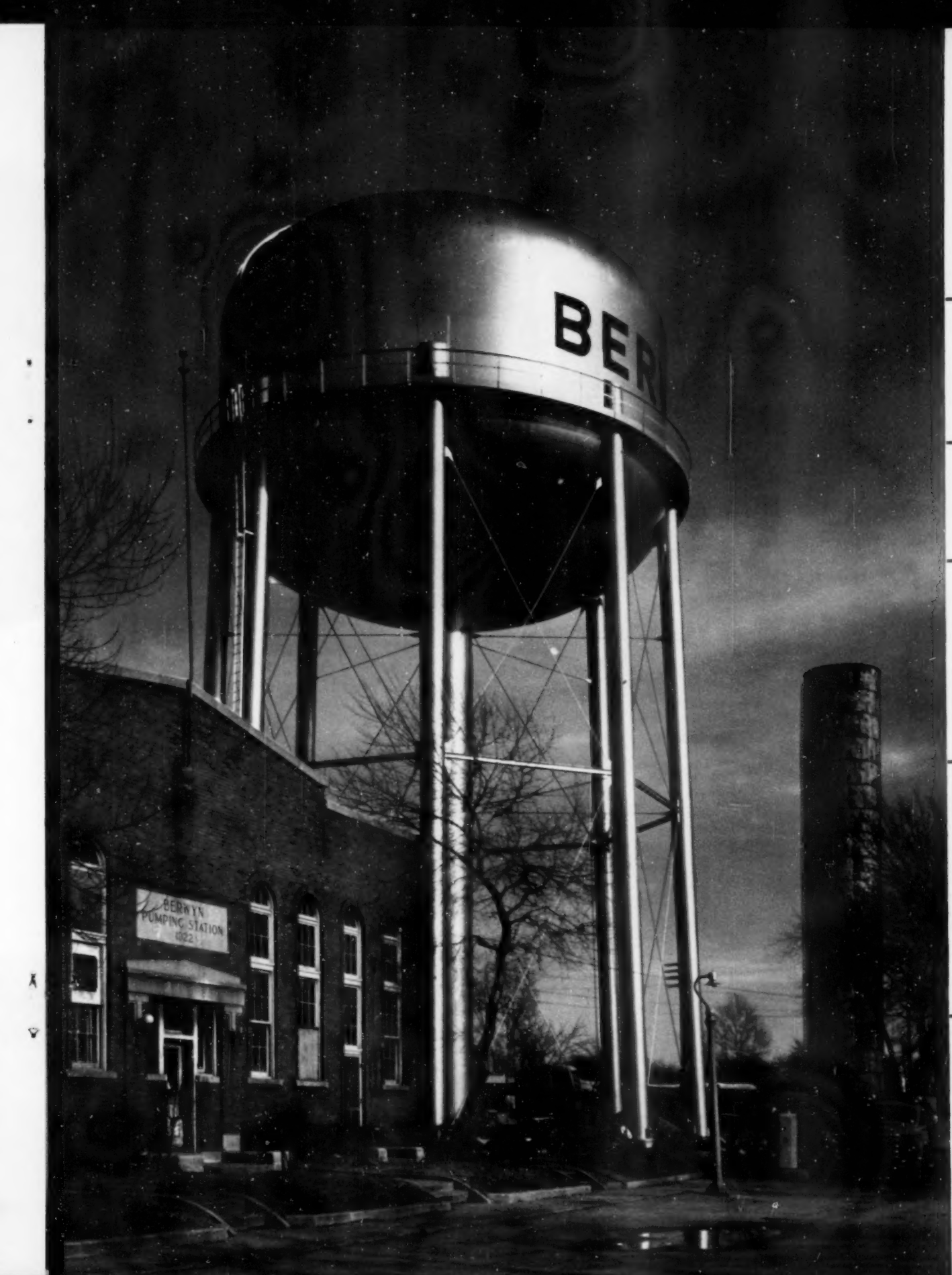
Henry J. Graeser is Superintendent of the Dallas, Tex., Water Works, which position includes responsibility for and direction of the sewerage system and the sewage treatment plant. He has held this position since 1955, and from 1950 to 1955 he was assistant superintendent.

A graduate of Texas A & M in 1938 with BS in Engineering, he was with the State Health Department for nearly three years, becoming in 1941 an engineer of the Construction Division, R & U, Corps of Engineers. He was one of the first few men commissioned in the Sanitary Corps in February, 1942, under the first augmentation plan. He served in the Sanitary Engineering Division Headquarters and in Camp Shelby, Miss., before going overseas, where he served in Leyte and Luzon, and at Base X in Manila. After discharge in late 1945 with a batch of ribbons and stars and with the rank of Major, he returned to the R & U Division for five years before going to Dallas.

Water consumption in Dallas in 1957 averaged 93 mgd and to meet this demand, plus the very high peak hourly use, for the fast-growing Dallas area, an extensive program of improvements is under way, even though he reports "two new reservoirs now full." The Sabine River supply which will be completed in 1963, will involve 33 miles of 72-in. pipeline, a reservoir of 900,000 acre-feet, ground storage and filtered water lines 72 to 96-in. diameter.

In the sewage treatment field, an additional 36 mgd unit is under design. This will reinforce the existing facilities now providing a high degree of treatment.

A licensed professional engineer and a member of NSPE, AWWA and FSIWA, Mr. Graeser is also active in the YMCA, Boy Scouts and Presbyterian Church. He and Mrs. (Doris) Graeser have two boys and a girl, ranging from 13 to 9—Henry, Lynne and John. As to hobbies, there is little time for them but he says "some day I hope to fish a little."



FILE REFERENCE

FACT SHEET

GRAVER®

New Elevated Tank for Modernized Berwyn, Ill. System

William J. Kriz, Mayor
Anton Pav, Commissioner of Public Works
Frank J. Broucek, Superintendent of Water
Edwin Hancock Engineering Company
Consulting Engineers, Chicago, Ill.
George D. Hardin
General Contractor, Chicago, Ill.
Graver Tank & Mfg. Co., Inc.
Design, Fabrication and Erection

Type: Double Ellipsoidal Elevated Tank
Capacity: 500,000 gallons
Height to Overflow: 100′
Head Range: 35′
Diameter of Tank: 52′
Built to AWWA Specifications
Painted, Sterilized and Cathodic Protected

THE PROBLEM

A thirty-six year old water system supplying the City of Berwyn, Ill., a suburb of 55,000 people near Chicago, was inadequate to maintain uniform water pressure throughout the city during peak demand periods. Chicago water flowed directly into Berwyn mains at 20 lbs. pressure and filled a surface reservoir during low demand. Pumps lifted water into two 150,000 gallon elevated tanks and a standpipe, but these were not high enough to maintain sufficient pressure and were used only for storage. City officials asked for the recommendations of a consulting engineering firm.

THE SOLUTION

A complete revamping of the system was recommended: four new pumps, larger piping at the Water Works and direct pumping from the large surface reservoir were part of the solution. In addition, a new 500,000 gallon elevated water tank, riding on the distribution system, replaced the two low 150,000 gallon tanks and the standpipe. There is now sufficient water in elevated storage to supply the system for about 2 hours during slack periods without pumping.

Graver was selected to design, fabricate and erect the new elevated water tank, as well as to remove the old elevated tanks and the standpipe. Cooperation between the Mayor, Commissioner of Public Works, the consulting engineers, the general contractor and Graver made possible the erection of the elevated tank with minimum inconvenience.

Problems of modernizing or building water supply facilities can be readily solved by talking with experienced consulting engineers and Graver. More than a hundred years of experience in tank fabrication and erection enables Graver to contribute strongly to your plans.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA

New York • Philadelphia • Edge Moor, Delaware
Pittsburgh • Detroit • Chicago • Tulsa • Sand Springs, Oklahoma • Houston • New Orleans • Los Angeles • San Francisco • Fontana, California

BUILDING FOR THE FUTURE ON A CENTURY OF CRAFTSMANSHIP IN STEELS AND ALLOYS

GRAVER®

DESIGNED, FABRICATED AND ERECTED BY

GRAVER®

GRAVER ELEVATED WATER TANKS

Graver elevated water tanks are expertly fabricated from carbon steel, stainless steel or aluminum at Graver plants across the country and are erected on the site by experienced Graver crews to the highest welding standards.

The selection of one of the standard sizes shown in the table offers the advantage of lowest cost and quick deliveries. Should one of the standard sizes not be suitable, special designs by Graver's engineers is a regular service.

Capacity Gallons	Diameter	Head Range	Number of Columns
25,000	18′-0″	13′-9″	4
30,000	18′-0″	16′-6″	4
40,000	20′-0″	17′-10″	4
50,000	22′-0″	19′-0″	4
60,000	24′-0″	19′-0″	4
75,000	26′-0″	21′-0″	4
100,000	28′-0″	23′-9″	4
125,000	30′-0″	25′-9″	4
150,000	32′-0″	27′-11″	4
200,000	36′-0″	29′-11″	5
250,000	40′-0″	29′-2″	6
300,000	44′-0″	30′-0″	6
400,000	50′-0″	30′-0″	8
500,000	55′-0″	30′-0″	8
750,000	65′-0″	35′-0″	8
1,000,000	86′-0″	25′-0″	12
1,500,000	104′-0″	25′-0″	12
2,000,000	112′-0″	30′-0″	16
2,500,000	122′-0″	30′-0″	16
3,000,000	124′-0″	35′-0″	20

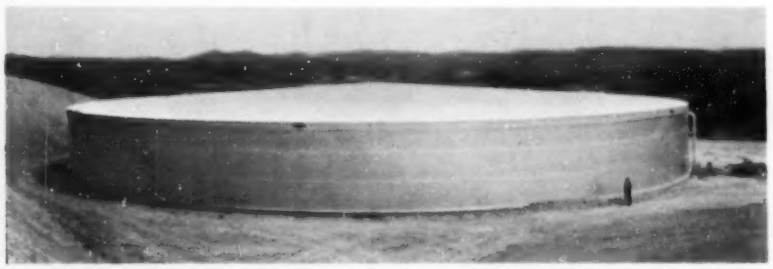
GRAVER PUMP SUCTION TANKS

Graver is an approved fabricator of pump suction tanks under the Factory Mutual Fire Insurance Companies specifications. All standard sizes shown in the table have ¼″ bottoms, 3/16″ self-supporting roofs and shells of thickness such that stress does not exceed 15,000 psi.

Rated Capacity Gallons	Actual Capacity Liquid Depth = Height—6″	Diameter	Height
100,000	100,470	27′0″	23′11½″
150,000	150,120	28′6″	31′11½″
200,000	200,730	33′0″	31′10½″
250,000	250,340	37′0″	31′ 7½″
300,000	300,550	42′0″	29′ 6″

GRAVER STANDPIPES AND RESERVOIRS

Water supply storage tanks whose height exceeds the diameter are referred to as standpipes. When the diameter exceeds the height, they are called reservoirs. Standpipes normally provide static head to the water distribution system; reservoirs usually are intended for storage and reserve supplies. For both types of water tanks, there can be no standard sizes offered. Since the size and form depend upon local conditions and individual requirements, standpipes and reservoirs must be designed in accordance with the special needs of the users and the characteristics of the site.



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REACH WORK IN ANY DIRECTION

POWERS-AMERICAN

"Sky-Master"®

HYDRAULIC AERIAL BEAM

Outer beam can be spotted anywhere in a 270° arc... inner beam anywhere in a 115° arc. Mast can be rotated continuously in either direction.

Sky-Master gets to out-of-the-way places that can't be reached with conventional aerial equipment ... saves time ... saves manpower ... often eliminates the need for rigging required on many overhead jobs.

With Sky-Master, it's unnecessary to "ground" an experienced man just because his climbing days are over. He can step into Sky-Master's insulated work basket, move the controls, and reach overhead work faster and safer than ever. When controls are released, Sky-Master stops right there—stays right there—until it's purposely moved. Can't creep even if hydraulic lines are damaged.

Sky-Master versatility is yours in one- and two-man models ... in sizes for reaching from 42′ to 48′ above ground.

Why not send for descriptive literature and prices on both models—today!

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Announcing the most revolutionary development

NOW! THE CENTRILINE PROCESS

THE
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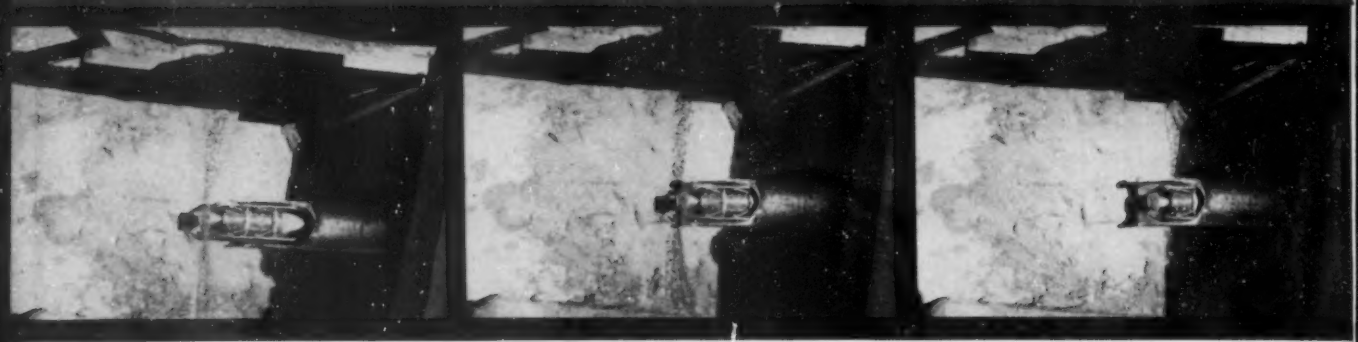
designed for 6" to 14" mains

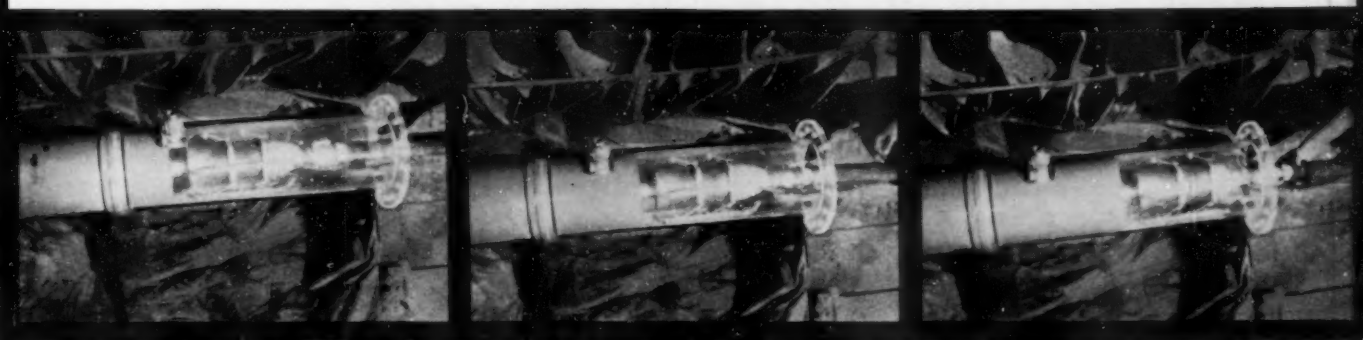


SEE THE NEW CENTRILINE MACHINE AND ITS PIPE LINING

AT BOOTHS 120 AND 121 · A. W. W. A. CONVENTION, DALLAS!

in the water works field in the past 15 years!

is also available for 6″ to 14″ mains



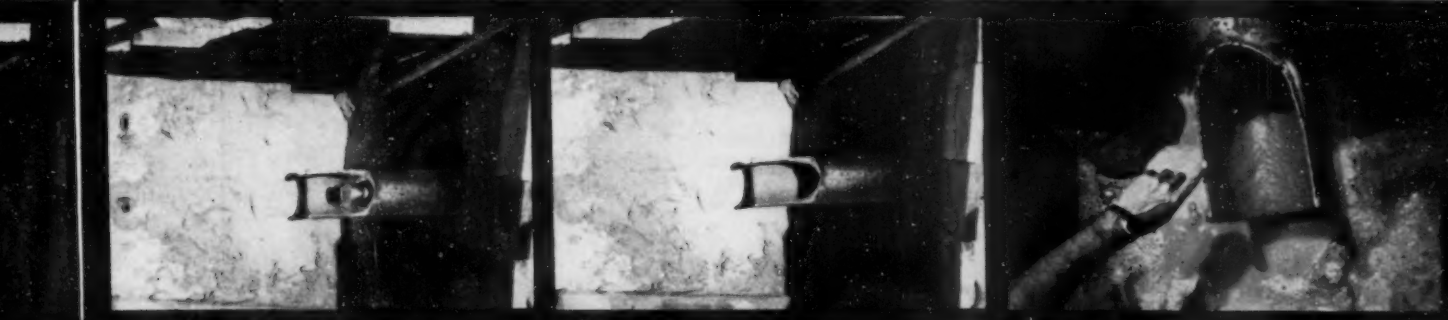
Cross section view, in special transparent pipe, showing new machine in action being pulled from left to right.

NOW, for the first time, your city's small but important transmission and distribution lines, including those used for fire protection, can regain their original flow capacity and pressure through the famous Centriline Process. A smaller version of the Centriline machine has been developed for use in 6″ to 14″ mains.

Here is how Centriline rehabilitates water systems' distribution grids. First, the pipes are cleaned to remove all tubercules, scale and loose materials resulting from corrosion. The Centriline machine is placed in the pipe and mortar is forced into a rapidly revolving head which applies a uniform coating on the pipe wall by centrifugal force. The thickness of the lining can be regulated by careful control of the machine. All of this is accomplished with a minimum of interruption to surface traffic, since the pipes are lined in place!

The advantages of using the new, small diameter Centriline machine in your mains are numerous. The new machine has a design feature which eliminates most excavations at valves, laterals and corporation cocks. The cost is lower than ever before. In addition, Centrilining permanently prevents future tuberculation, corrosion or leakage . . . reduces maintenance and pumping costs . . . raises distribution pressures and efficiency and extends the life of steel or cast iron pipe indefinitely. Send today for your free copy of our illustrated booklet which fully describes how Centriline can help you salvage worn out water lines of every size.

View of machine at work in special cut away pipe illustrating centrifugal application of cement-mortar.



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A Subsidiary of Raymond Concrete Pile Company

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New York 6, N.Y.
WOrth 2-1429

Branch Offices in Principal Cities of the United States, Canada and Latin America

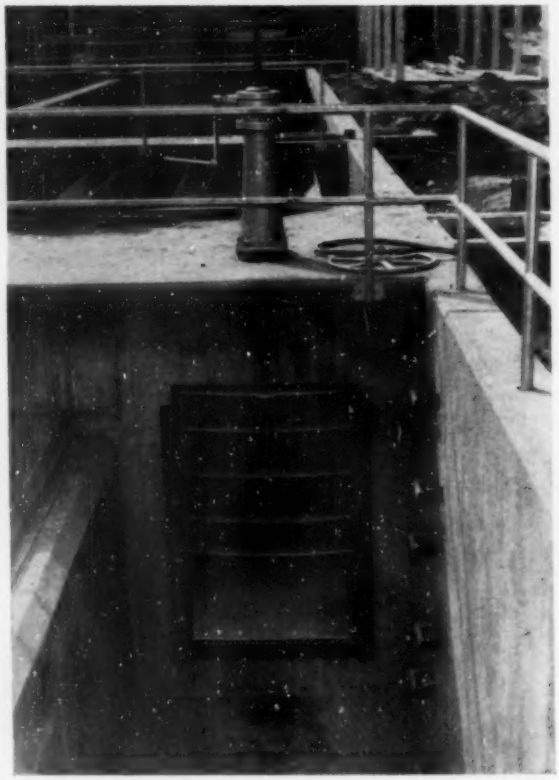
ARMCO GATES control flow at new Owensboro sewage plant

Armco Gates have an important role in a new $2.8 million primary sewage treatment plant at Owensboro, Kentucky. This plant is designed to handle an average flow of 7.5 million gallons a day, or a maximum peak flow of 30 MGD.

Included in the new plant are two 42-inch square Armco sluice gates to control discharge from the settling basins. A battery of Armco light duty slide gates controls and distributes the incoming flow. And an 8-inch square Armco Gate controls cross flow between the settling tanks.

These are typical of the many uses for Armco Gates. You too can find the answer to your sewage or water control problems from the more than 600 sizes and models of Armco Gates.

For more information, fill out and mail the coupon below for your copy of "Armco Gates for Efficient, Trouble-Free Water and Sewage Control." Armco Drainage & Metal Products, Inc., 4538 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.



Armco Drainage and Metal Products, Inc.
4538 Curtis Street, Middletown, Ohio

Send me the folder, "Armco Gates for Efficient, Trouble-Free Water and Sewage Control." I am interested in Armco Gates for the following uses:_____

_____

_____

NAME_____

ORGANIZATION_____

STREET_____

CITY_____ ZONE____ STATE_____

ABOVE: This 42 by 42-inch Armco Gate controls discharge from settling basin at new Owensboro sewage treatment plant.

RIGHT: Armco Gate, 8 inches square, with a non-rising stem controls cross flow between settling tanks.

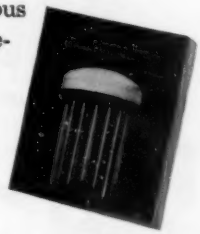
ARMCO®

MODERN WATER STORAGE at Pueblo, Colorado

750,000 gallon tank on 120 ft tower.
Diameter 62 ft. Head range 35 ft.

by
Pittsburgh-Des Moines

These fine-appearing PDM Radial Cone Elevated Steel Tanks serving the city of Pueblo typify the value, craftsmanship and dependability inherent in Pittsburgh-Des Moines water storage units of every type. Full information on the various designs, with tables of capacities and numerous photographs, are presented in our 20-page Elevated Tank Brochure. Write for your copy.



1,500,000 gallon capacity tank on 70 ft tower. Diameter 88 ft. Head range 35 ft.

PDM
ELEVATED STEEL TANKS

Pittsburgh-Des Moines Steel Company

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Tyton Joint® assembles so easily even untrained crews become expert in minutes. Only one accessory needed – a specially designed rubber gasket that fits into the bell of the receiving pipe. As the entering pipe slides in, it compresses the gasket to give a permanent, tight seal. No

U.S. cast iron PIPE

FOR WATER, SEWERAGE AND

does it!

bell holes. No caulking equipment. No nuts or bolts to fasten. And no weather problems. Tyton Joint pipe can be laid in rain or wet trench if need be. Like to know more about the pipe joint that saves time, money and headaches from one end of the line to the other? Call or write today.

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE

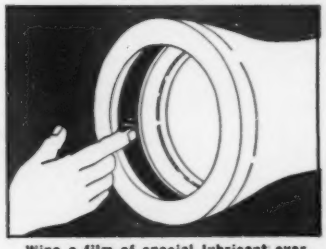
"SHECKS, WE DIDN'T NEED YORE MUSCLES, AUNT BEANY... A LI'L PUSH FROM ANY ONE OF US PUTS IT TOGETHER."

INDUSTRIAL SERVICE CAST IRON

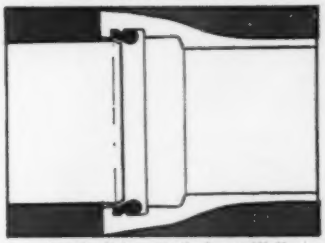
TYTON

ONLY FOUR SIMPLE ACTIONS

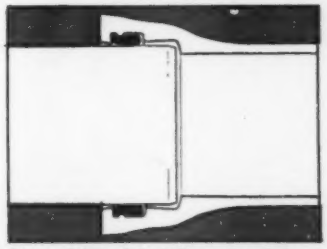
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket

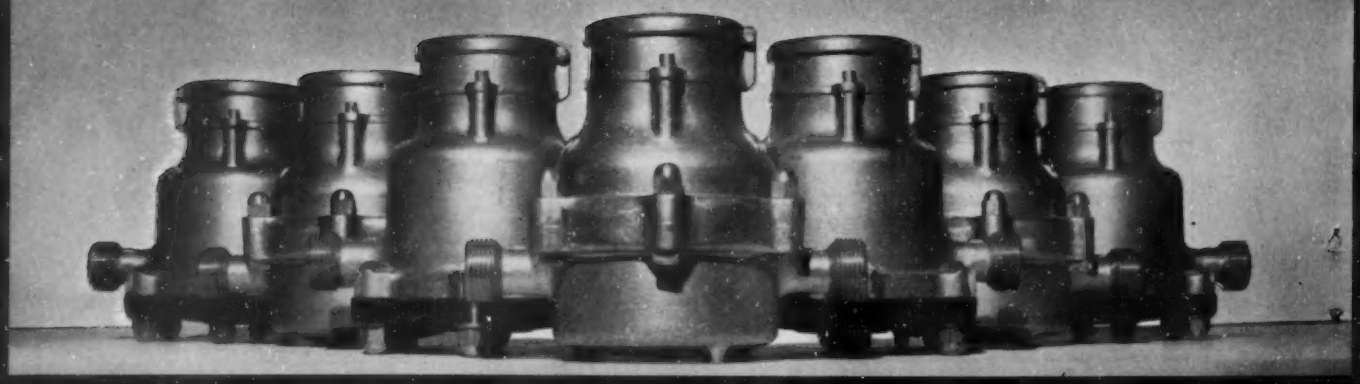


Force plain end to bottom of socket... the job's done!

8" Tyton Joint pipe for water main addition in Colorado.

The best WATER METER you can buy

HERSEY



For information and literature on the most complete line of Water Meters,
contact our nearest Branch or the Home Office

HERSEY MANUFACTURING COMPANY

DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

what's it worth to always face your work

DAVIS LOADER-BACKHOE

lets you see what you're doing

A Davis Loader-Backhoe combination will put money in your pocket by outperforming any other rig—pound for pound, dollar for dollar.

EXCLUSIVE FLUSH DIGGING—Entire mast and boom assembly shifts from center to either side for flush digging alongside buildings, fences, hedges, and other obstructions. Only Davis has this advanced feature.

You will be amazed how many man hours a Davis Loader-Backhoe will knock off your production schedule.

Notice how the seat of the Davis Backhoe revolves with the boom and bucket. ***You always face your work!*** You can be more accurate and you're not as tired at the end of a long day.

Big Machine Performance—Only Davis offers this along with other "big machine" features, such as individually controlled vertical stabilizers, 10,000 pounds breakaway, streamlined hydraulic system with finger-tip valve controls, and continuous operating arc.

Exclusive Versatility—Interchangeable Digging Position of the Model 210 lets you shift the Backhoe from the center to either side of the frame. Gives you versatility for digging flush alongside a building . . . extra reach to the side or for trenching along an embankment or slope.

No wonder the Davis Loader-Backhoe has become America's largest selling rig—it's priced lower than most competitive models, too!

Davis Loaders and Backhoes are available for all popular models of International, Ford, Fordson Major, Ferguson, Case, Massey-Harris, Allis-Chalmers, Oliver, John Deere, Minneapolis-Moline, and Work Bull Tractors.

SOLD AND SERVICED EVERYWHERE BY BETTER DEALERS

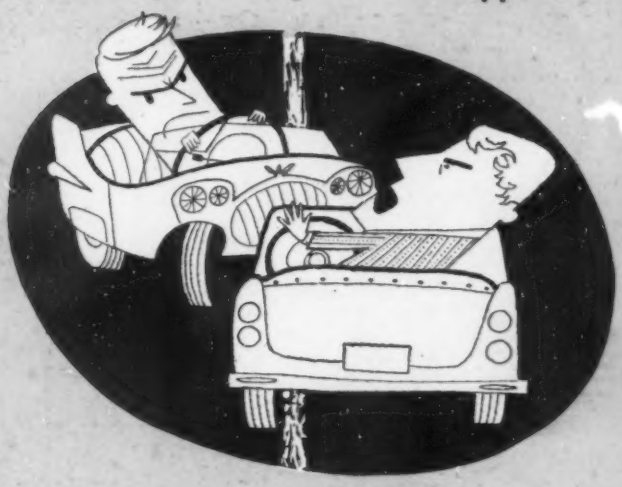
For the name of your nearest dealers call Western Union by number and ask for Operator 25 . . . or write direct. Please specify make of tractor.

MASSEY-FERGUSON INDUSTRIAL DIVISION

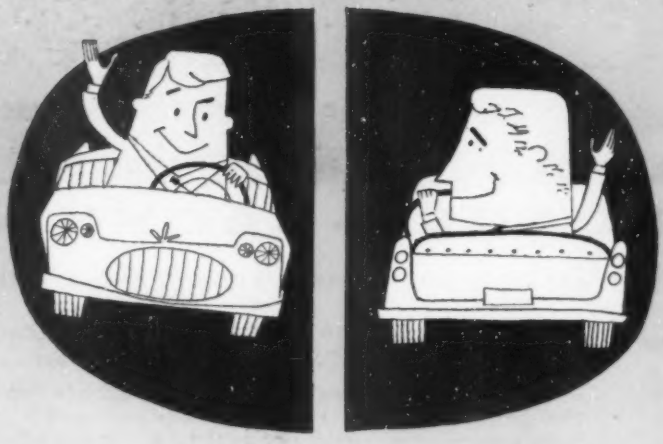
MASSEY-HARRIS-FERGUSON, INC.

1009 S. WEST STREET • WICHITA 13N, KANSAS

when ordinary markings have disappeared...



guaranteed perma-line is still on the job!



for safety: Only PERMA-LINE—the new thermoplastic traffic marking material — guarantees clean, crisp, visible lines that compel drivers and pedestrians to obey safety regulations.

for durability: Only PERMA-LINE guarantees completely effective year 'round markings—even under heaviest traffic conditions—because PERMA-LINE outlasts older methods 6-8 times.

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For free illustrated brochure and the name of your nearest distributor fill in this coupon.

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TAX REDUCTION AND PUBLIC WORKS

There is much thought about ways and means to bolster our national economy and thus arrest the present so-called business recession and avert a much feared further increase in unemployment throughout the nation. Of the many ways thought about those most often and seriously proposed are: 1) A reduction in the income tax; and 2) the creation of Government sponsored work projects, such as PWA, etc. during the former depression.

Certainly both of these have their good points and may be helpful to a degree; but neither, in itself, can satisfactorily accomplish the purpose for which it is intended. A combination of them, however, may do so.

Let us assume that the budget has been balanced, and that it is possible to make a reduction in income tax. It is proposed that the income tax be not reduced directly to the tax payer at the time of his tax return or tax payment, but that to each tax district there be credited for return an amount equal to the percentage of the national tax reduction based on the actual tax collected from that district.

The tax return so credited should be made available directly to the separate governmental agencies within that tax district to be used for public improvements that would normally result in a tax, a levy or a charge to the public within that governmental subdivision.

In this manner, the tax burden would be reduced to the citizens indirectly and in just proportion to the local tax load. In every locality, local activity by building would be stepped up and jobs would be created in fair proportion to the tax monies returned and to the population within that area.

For the purpose of analyzing what would happen, the writer has chosen the Toledo, Ohio, of Northwestern Ohio Federal Taxing District which is composed of 25 counties in north-

western Ohio. Total population in the area is 1,250,000. The Federal tax collected during fiscal year 1957 was: Personal income tax $366,000,000; and corporation tax $222,000,000. The total is $588,000,000, or $474.04 per person per year, for the Northwestern Ohio district, based on the 1950 population census.

The writer has compiled the values and percentage of population, the amounts contributed and the return that would be made on the basis of a 2 percent or 5 percent tax reduction in the manner outlined. Under the plan for instance, the City of Toledo, with a population of, let us say 304,000 (1950 census) (approximately 77.0 percent of the population in Lucas County) would, (under the 5 percent plan) receive an annual return from income tax in the amount of $7,167,190. Thus, Toledo could build its new and badly needed City Hall and Public Service Buildings and year after year continue its program by providing better school buildings, recreation facilities, roads and highways. Many of the smaller communities, now so badly in need of sanitary facilities, could find a way to finance these projects on their own and thus improve living conditions in their own communities by constructing water and sewerage works and at the same time create jobs to relieve unemployment in the immediate area.

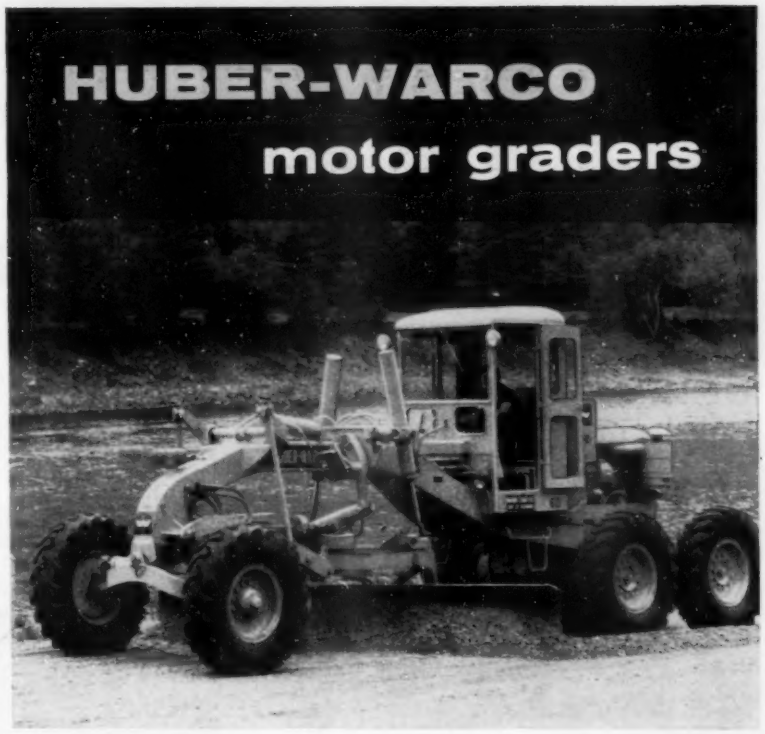
George J. Van Dorp
Chief Engineer, Division of Water
Toledo, Ohio

SAVING MANHOURS WITH COMPUTERS

I read with a great deal of interest, "Engineering Manhours Saved With Electronic Computer" in your Highway & Airport Digest for February PUBLIC WORKS. The engineering firm with which I am associated has most recently embarked on the electronic road.

With regard to the computer in engineering. All that has been said is true, and savings in time required for the calculations of major engineering problems, can be just short of fantastic. I can personally attest to the traverse closure problem solved with the computer. You undoubtedly recall what a laborious thing it was to do a traverse problem, with perhaps a mere 10 sides. Longhand with logarithms! Here is what we can do:

Input directly to the computer 64 sides, a different temperature for every side, 64 interior angles in degrees, minutes, and seconds, and one



handles wide range of county jobs

Huber-Warco MOTOR GRADERS have proved to be an important part of the equipment fleet for many counties in the United States. Whether the assignment is for tough grading, shoulder maintenance, snow removal, ditching, or a variety of other jobs, Huber-Warco MOTOR GRADERS can do the job better. Models are available with torque converter or standard transmissions, and range from 75 to 195 h.p. Other features include . . . interchangeable tires . . . 360° blade rotation without removing scarifier teeth . . . hydraulically cab-controlled 90° blade change, either side, with no manual adjustments . . . and a power-sliding moldboard. Your Huber-Warco distributor can give you complete details.

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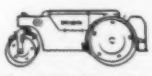
MOTOR GRADERS

TANDEM ROLLERS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☐ Send specifications on Huber-Warco motor graders.
Send specifications on: ☐ Maintainer
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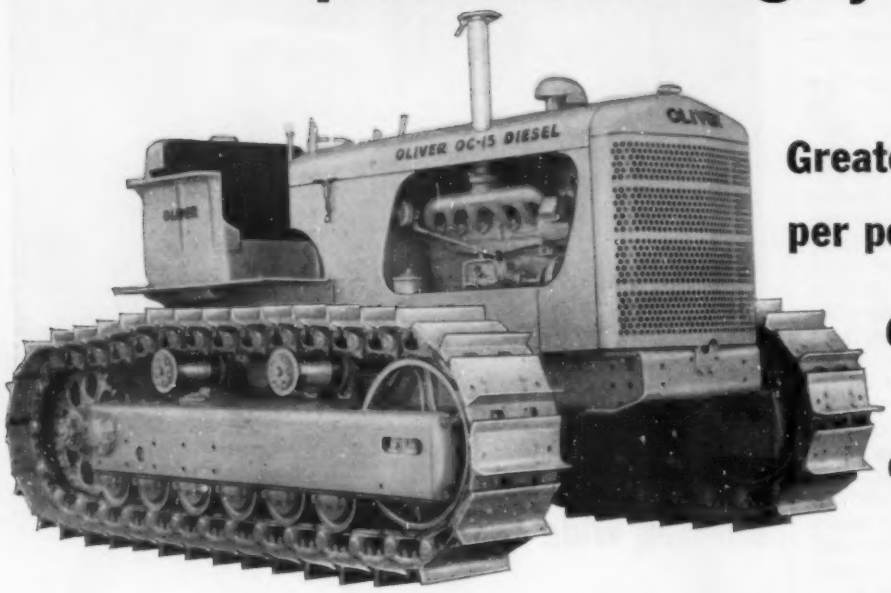
4-PW

HUBER W WARCO

OLIVER

presents the mighty OC-15



Greatest horsepower per pound of tractor

Greatest return per dollar invested!

In nationally recognized official tests, the OC-15 came out first for power against every other tractor in its size class. It's the power leader *any way you rate it!* In total, the OC-15 is the most powerful, performance-packed, profit-making crawler for its size yet. It's 1958 modern...and ready for you right now!

- Greatest power to weight ratio...a full 110 net engine h.p. High-torque, 529-cubic-inch diesel.
- Has more reserve power—you work faster, more efficiently with any mounted attachment.
- Handles wider work range—all at less cost per yard-moved with its fuel-thrifty full diesel. 24-volt starting.
- Long 87⅛" crawlers with greater ground contact, higher flotation, tremendous traction! Six lower track wheels.
- Two-track turning action...easy air-steering operation.
- Heaviest-duty, service-saving design—reinforced and trussed at every stress point.
- Compare it on every count—price especially. You'll want the OC-15!

Oliver OC-156 Loader—gives a new speed and work range to your operations. Designed and factory-built as an integral tractor-loader, the big 2¼-yd. loader is matched to the full capabilities of the powerful tractor. Tremendous hydraulic bucket break-out action for toughest digging...high bucket lift for faster, more efficient loading. A lasting investment in lowest cost digging-loading-backfilling and other services.

OLIVER **THE OLIVER CORPORATION**

Industrial Sales Div., 19300 Euclid Ave., Cleveland 17, Ohio

a complete line of industrial wheel and crawler tractors and matched allied equipment

starting azimuth. In 30 to 40 minutes the machine prints out (after closing and balancing the traverse): 1) The original error of closure; 2) co-ordinates of each point; 3) azimuth in degrees, minutes, and seconds, and distance of each side; and 4) area of enclosed traverse in square feet, and acres. I have never seen a 64 sided traverse, much less solved one. But judging from some traverses I have done, I would say if one man could do this job in one week it would be a phenomenal achievement.

We believe that our computer (Royal McBee LGP-30) will enable us to seek out and perform creditably, jobs which heretofore may have been beyond our reach.

Jean O. Frank
Brender and Brender Engineers
Wayne, Michigan

LOCALLY INSPIRED TRAINING PROGRAMS

I read with a great deal of interest your article "Focusing National Attention on Water and Sewage Works Operator Training" under your "Point of View." We, here at Rock Island, are great believers in thoroughly training all of our men.

I started a course "Concepts of Management" which runs for two hours each week and will take 11 or 12 nights. Men invited are potential leaders, leadmen, foremen, supervisors, mechanics and lab technicians from the sewer and water divisions —including sewer line maintenance.

Along with this and having them attend state and regional schools, we try to develop all of our men by taking them through the other three divisions of the utilities; then we give them a short course on their work in connection with their own division. We also have a weekly meeting lasting for an hour, during which time I explain the functions of their own division.

We always read your magazine because it gives us the kind of helpful information we are looking for along with the ads, etc.

Harley Boeke
Director of Public Utilities
Rock Island, Ill.

• • •

Equipment Use in Newton, Mass.

The Division of Equipment, Street Department, Newton, Mass., is responsible for the maintenance and upkeep of 15 automobiles, 111 trucks and 266 other pieces of equipment. During the fiscal year, 232 new tires were purchased and 360,000 gallons of gasoline were used.

HUBER-WARCO
motor graders

5D-190 . . . world's most powerful

The Huber-Warco 5D-190 MOTOR GRADER has been designed to make faster passes and smoother cuts for more profitable grader operation. Features include: 195 h.p. diesel engine . . . torque converter . . . tail-shaft governor . . . power-shift transmission . . . and NO CLUTCH. The operator sets the desired speed and the tail-shaft governor maintains that speed regardless of load conditions. The Huber-Warco 5D-190 is "power-packed" to handle a tough grading assignment quickly and efficiently. See your Huber-Warco distributor for complete details.

MAINTAINER

MOTOR GRADERS

TANDEM ROLLERS

3-WHEEL ROLLERS

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Send me specifications on the Huber-Warco
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Send specifications on: ☐ Maintainer
☐ Tandem Rollers ☐ 3-Wheel Rollers

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HUBER W WARCO

EQUIPMENT and MATERIALS

FOR YOUR

PUBLIC WORKS PROGRAM

NEW LISTINGS

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field of cities, counties or states.

Aluminum Lighting Standard Catalog

768. This 16-page catalog contains complete engineering data and illustrations of the various types, sizes, weights and spans of lighting standards. Check the reply card or write Kerrigan Iron Works, Inc., Nashville 2, Tenn., for this valuable catalog.

Information For Engineers on Zeolite Softeners

769. A 12-page Bulletin #5763 on zeolite softeners that is well illustrated and contains useful information for engineers and operators of water treating equipment is available from General Filter Co., 923-925 Second St., Ames, Ia. Check the reply card.

Mercury Vapor Floodlighting Bulletin

770. This 18-page, 2-color bulletin contains the latest information on the operating characteristics and economies as well as the color characteristics of all the currently available mercury vapor lamps. Check the reply card or write The Pyle-National Co., 1334 N. Kostner Ave., Chicago 51, Ill., for Bulletin No. 640.

Flocculation Equipment For Water and Sewage Plants

777. Bulletin No. 315-51 outlines the flocculation process, illustrates the wide selection and application of flocculation equipment and gives technical details of Rex Flocculators. Check the reply card or write Chain Belt Co., Milwaukee 1, Wisconsin, for this information on water, sewage and waste treatment.

Catalog on All Phases of Brush Disposal

771. This informative 2-color catalog gives complete detailed information on Fitchburg Chippers, and includes drawings, specifications, diagrams and charts. Check the reply card or write Fitchburg Engineering Corp., Fitchburg, Mass., today.

Hydraulic and Manual Pipe Pushers

772. Giant pipe pushers will install any kind of pipe or conduit up to 15 ins. in diameter and in lengths up to 200 ft. Prices, models and specifications are covered in catalog from Giant Mfg. Co., Council Bluffs, Ia. Check the reply card.

Bituminous Maintenance Distributor

773. An illustrated bulletin which shows how a bituminous maintenance distributor features uniform coverage and mounts and operates on a standard truck, is available from Rosco Mfg. Co., Minneapolis, Minn. Check the reply card.

Engineering Data and Details on Prestressed Concrete

774. Stressteel Manual SS-3 provides description of Stressteel materials for post-tensioned, prestressed concrete applications. Engineering data, specifications and procedures are also included. Write Stressteel Corp., 221 Conyngham Ave., Wilkes-Barre, Pa., or check the reply card.

Transite Pressure Pipe For Water Systems

775. Transite pressure pipe and the Ring-Tite coupling are described in Bulletin TR-160A from Johns-Manville, 22 East 40th St., New York 16, N. Y. Check the reply card for full details on this water pipe.

Filter Operating Control Desk

776. Literature describes and illustrates 3 desk-type control panels used in water treatment plants for operation of rapid sand filters. Dimensions and specifications are included. Check the reply card or write Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio, for your copy.

Guide to Effective Sewage Disposal

778. A 40-page primer on sewage pumping and treatment is available from Yeomans Brothers Co., Dept. P, 1999 North Ruby St., Melrose Park, Ill. A variety of situations in the collection, disposition and treatment of sewage is covered. Check the reply card.

Tyton Joint For Water

779. McWane Tyton joint and mechanical joint cast iron pipe are described in catalog from McWane Cast Iron Pipe Co., Birmingham 2, Ala. Check the reply card for details on pipe from 2 through 12 ins.

Catalog on Your Optical Needs

781. Catalog L-117 contains information on unmounted optical parts, including lenses, prisms and reflectors. Check the reply card or write Bausch & Lomb Optical Co., Rochester 2, N. Y., for complete details.

Combination Unit Degritting Clarifier and Clarigester

782. Degritting unit provides positive mechanical grit removal with conventional clarification in a single tank. Bulletin No. 6412 is available from Dorr-Oliver Inc., Stamford, Conn., or by checking the reply card.

Calgon TG For Better Corrosion Control in Water Systems

780. Calgon Composition TG is a sodium-zinc hexametaphosphate corrosion inhibitor for municipal water systems. Bulletin 420-12-9 is available from Calgon Co., Hagan Chemicals & Controls, Inc., Hagan Bldg., Pittsburgh 30, Pa., or by checking the reply card.

Asphalt Anti-Stripping Additives

783. How asphalt anti-stripping additives can be applied in all types of weather is described in bulletin called "Redicote" available from Armour and Co., Chemical Div., 1355 W. 31st St., Chicago 9, Ill. Check the reply card.

How to Measure Your Filing Costs and Efficiency

784. Handy guides for measuring filing costs and results along with a detailed plan of action to improve filing efficiency are made available in a 28-page Manual from Remington Rand, Div., of Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y. Check the reply card.

Use The Reply Card

Automatic Pressure Control Valves

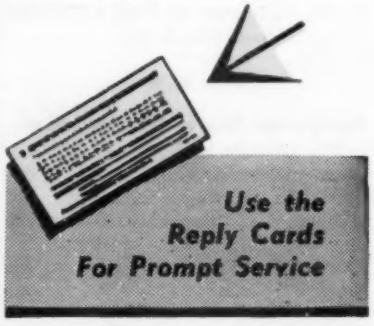
785. Pressure reducing, regulating, needle, relief, altitude and balanced float valves and level controllers are covered in 101-page manual from Ross Valve Mfg. Co. Inc., Troy, N. Y. Check the reply card.

Problems Solved By Electronic Computing

707. Electronic computing, data processing and related services on an economical job or contract basis are described in literature available from Datics Corp., P. O. Box 9128, Fort Worth, Tex. Many engineering problems can be solved by this company. Check the reply card.

Information on A Steel Weight Finder

711. Covered in literature is a slide chart that determines accurate weights and dimensional data on angles, beams, channels, rounds, squares and plates. Check the reply card or write Alcott Calculator Co., P. O. Box 4606, Fort Lauderdale, Fla.



To order these helpful booklets check the reply card opposite page 36.

NEW LISTINGS (Cont.)

Cast Iron Fittings For All Types of Water Pipe

21. Short body and mechanical joint water-main fittings—2" through 12", standard bell spigot fittings—2" through 36", ring-tite fittings—3" through 12" and fluid-tite fittings—3" through 12" are covered in literature from Trinity Valley Iron and Steel Co., P. O. Box 664, Forth Worth, Texas.

Catalog Covering Traffic Signs and Reflective Pavement Marking

30. All signs with standard legends and meeting State and U. S. standard specifications are described in this buying guide plus special signs, posts and mounting accessories. It also illustrates reflective materials for pavement marking, buttons and beads. Copies available from Cataphote Corp., Toledo 10, Ohio.

Tractor Loader Can Be Converted Into Eight Different Machines

38. Multiple-purpose tractor loader can be converted to a street sweeper, backhoe, fork lift, angle dozer, crane and rotary broom in a short time. Check the reply card or write Massey-Ferguson Industrial Div., 1009 South West St., Wichita 13N, Kans., for well illustrated catalog.

Calcium Chloride For Road Construction and Maintenance

41. Calcium chloride for concrete road construction, for maintenance of unpaved roads and for the control of ice are covered in literature from The Dow Chemical Co., Dept. CC503A, Midland, Mich. Check the reply card.

Plastic Wash Troughs For Water Treatment

45. Leopold fiberglass-reinforced plastic wash troughs for water treatment are described in literature from F. B. Leopold Co., Zelienople, Pa. Check the reply card for data on these units that will last for years without any painting or other maintenance.

Modern Electronic Pipe Detector

46. Detect, trace and center pipes and cables and be able to estimate their depth with these new detectors. Check the reply card or write Computer-Measurements Corp., 5528 Vineland Ave., Dept. 55-B, North Hollywood, Calif., for this complete catalog on this electronic device.

Membrane Filter Media For Bacteriological Analysis

48. Isopor DSN dehydrated pads, impregnated enrichment nutrient or differentiating media are supplied with MF membranes. Literature is available from AG Chemical Co., Box 65C, Pasadena, Calif., or by checking the reply card.

Automatic Sample Driver For Sub-Surface Exploration

49. This compact portable drilling unit features augering, driving and core drilling for sub-surface exploration. Check the reply card or write Penndrill Mfg. Div., Pennsylvania Drilling Co., 1201-1205 Chartiers Ave., Pittsburgh 20, Pa., for full information.

Fast, Smooth Pipe Cuts

53. The Fein automatic pipe saw cuts cast iron or steel pipe from 6 to 60 inches. Sets up easily, operates in or out of a trench and cuts up to a 2-in. wall thickness. Literature from Prescott Tool Co., Inc., Box 7, Greendale Branch, Worcester 6, Mass., or by checking the reply card.

Combating Odors At Treatment Plants

55. Odor counteractants and consultant service on odor problems at sewage treatment plants are described in literature from Airkem, Inc., 241 E. 44th St., New York 17, N. Y. Check the reply card today.

Saw Cuts Cast Iron or Steel Pipe

56. The Wachs National air-powered saw cuts cast iron or steel pipe from 10 to 72 ins., leaving a clean-cut, milled edge. Guillotine-type saw handles smaller pipe up to 16 ins. Get full information on these units from E. H. Wachs Co., 1525 No. Dayton St., Chicago 32, Ill., or by checking the reply card.

for service in material handling

Quickly and easily, the hydraulically controlled lift-loader attachment converts the Huber-Warco M-52 MAINTAINER for service in material handling. The ⅜ cu. yd. bucket has a lifting capacity of 1700 lbs., and a lifting height of 9'-6". The design of the MAINTAINER provides a dumping clearance of 8' and permits the unit to move in close to the truck. The 45½ h.p. M-52 MAINTAINER with torque converter will perform a variety of services in addition to routine grading and lift-loading assignments. With other hydraulically controlled attachments the M-52 MAINTAINER will also serve as a bulldozer, berm leveler, side dozer, broom, highway mower, snow plow or patch roller. See your Huber-Warco distributor for complete details.

3-WHEEL ROLLERS

MAINTAINER

MOTOR GRADERS

TANDEM ROLLERS

Products of HUBER-WARCO COMPANY, Marion, Ohio, U. S. A.

HUBER-WARCO COMPANY, Marion, Ohio, U.S.A.

☐ Send specifications on the Huber-Warco M-52 Maintainer.

Send specifications on: ☐ Motor Graders ☐ Tandem Rollers ☐ 3-Wheel Rollers

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Title .....

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HUBER W WARCO

To order these helpful booklets check the reply card opposite page 36.

WATER WORKS

Do You Have An Independent Source of Electricity?

27. An independent source of electricity which will supply power for vital services when regular sources fail can be invaluable during emergencies. Check Kohler Bulletin KEP 56-1 which furnishes data that will help you select the plant best suited for your needs. Many models, 500 watt to 50 Kw, portable and stationary are described. Write the Kohler Co., Kohler, Wis., or use the reply card.

Efficient Coagulation With Ferri-Floc

69. Advantages claimed for Ferri-Floc as a coagulant include wide pH range, quick floc formation, manganese removal control of certain tastes and odors plus other aids in high quality water production. Check reply card for complete Ferri-Floc data. Tennessee Corp., Grant Bldg., Atlanta, Ga.

Convenient Reference Manual Covers Cast Iron Pipe, Valves and Hydrants

76. An 80-page manual, issued by R. D. Wood Co. Independence Sq., Philadelphia 5, Pa., presents specifications for "Sand-Spun" cast iron pipe and fittings, outlines types of joints available, lists dimensions and weights in convenient tables and includes, in addition, full engineering data on the Mathews fire hydrant and R. D. Wood gate valves.

Now Every Municipality Can Own a Trencher

173. The low cost of the Blackhawk Trench Hog, a tractor-mounted ladder type trencher makes it profitable for many municipalities to own their own trencher. Be sure to investigate this versatile machine which digs trenches to 7 feet deep, 20 inches wide. Illustrated bulletin available from Arps Corp., New Holstein, Wis. Just check the reply card.

Elevated Tanks and Other Storage Facilities

32. Specification sheet covering elevated tank sizes and design and illustrated brochure available from the Darby Corp., Kansas City 15, Kansas.

Easily Cleaned Long Run Filter Bed Media

70. Bulletins on Anthrafilt tell the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Have you made a full investigation? Write Anthracite Equipment Corp., Wilkes-Barre, Pa.

Engineering Data on Screening Equipment

77. Water, sewage and industrial waste screening equipment is fully described in a 28-page book. No. 2587, offered by Link-Belt Co., Colmar, Pa. Complete data for the engineer and tables to determine the proper size unit for handling various capacities are included. This valuable comprehensive booklet may be obtained by checking the reply card.

Automatic Engine Control Equipment Manual

83. This catalog contains descriptions of standard automatic and semi-automatic controls and control equipment. General control recommendations, control selection chart, accessory selection chart, safety stop controls and alarm sets are sections covered. For price lists and models available write Synchro-Start Products, Inc., 8151 N. Ridgeway, Skokie, Ill., or check the reply card.

Manual on Instrument Accessories and Supplies

96. The 60-page loose-leaf book, Catalog 500, includes specifications, part numbers and prices for more than 250 commonly furnished instrument parts and supplies. It is divided into 5 sections: Mechanical; pneumatic; electric-electronic, general, and tools and service. Check the reply card or write The Foxboro Co., Foxboro, Mass., for your copy.

All-Electric Floatless Liquid Level Control

174. Description of operating principles and application of B/W controls show the simplicity and many uses of these all-electric, floatless devices. Get latest bulletins for engineering data, diagrams of typical installations and details of component parts. Check the reply card or write B/W Controller Corp., Dept. PW, Birmingham, Mich.

Rapid Sand and Pressure Filter Data

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa., or check the reply card.

Engineering Data On Gravity Filter Design

170. The complete line of gravity filters and related accessories furnished by the Permutit Co., New York 36, N. Y., is covered in a well-illustrated 24-page booklet. Each element of a filter and filter controls are discussed in detail to assist the designer of these important units. Check the reply card.

Submersible Pumps For Municipal Use

185. A new 12-page bulletin that describes the line of BJ submersible pumps is available from Byron Jackson Pump Inc., P. O. Box 2017, Terminal Annex, Los Angeles 54, Calif. Construction and operation of the pumps are covered along with a handy selection chart that gives capacity and head performance.

Design of Prestressed Concrete Tanks

194. An 8-page technical Bulletin, T-19, on the Design of Prestressed Concrete Tanks, gives engineering data and formulas of general interest to anyone considering prestressed concrete for storage tanks. Check the reply card or write The Preload Co., Inc., 21 East 37th St., New York 16, N. Y.

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- Filters: 2-SPF-129 R. P. Adams Company, Inc.

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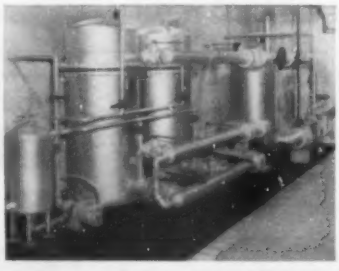

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The R. P. Adams Company is the nation's largest manufacturer of filters exclusively for municipal, commercial and institutional pools.

For detailed information, write for our new technical Bulletin 626. It was prepared to help you with your swimming pool filter problems.

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Dallas, Tex., Apr. 20-25

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Dallas, Tex., Apr. 20-25

California Section, FS&IWA
Stockton, Calif., Apr. 23-26

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Cincinnati, Ohio, Apr. 28-May 9

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Roanoke, Va., Apr. 28-29

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Durham, N. C., May 1-2

Purdue Industrial Waste Conference
Lafayette, Ind., May 5-7

Pa. Society of Professional Engineers
Reading, Pa., May 8-10

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Rochester, N. Y., May 11-13

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N. Y. State Ass'n. of Municipal Engineers
Lake Placid, N. Y., June 2-4

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Gardner, Mass., June 4-5

Alabama Section, FS&IWA
Auburn, Ala., June 4-6

Material Handling Exposition
Cleveland, Ohio, June 9-12

National Society of Professional Engineers
St. Louis, Mo., June 11-14

Maryland-Delaware Section, FS&IWA
Frederick, Md., June 12-13

Western Area Spring Conference, APWA
San Diego, Calif., June 15-18

Public Works Congress & Equipment Show, APWA
Kansas City, Mo., Sept. 28-Oct. 1

National Institute of Governmental Purchasing, Inc.
Boston, Mass., Oct. 5-8

Federation of Sewage & Industrial Wastes Ass'n.
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Two New High-Capacity Asphalt Plants Announced by Barber-Greene

These two new continuous asphalt plants give greater versatility than ever before available. The same mixer, without alteration, may be used with any combination of plant components to produce all types of mixes—from the simplest cold mixes to the highest types which must meet the most rigid specifications. Model 847 is for high capacity. Model 848-A is for extra high capacity.

It is only necessary to transport and operate the components required for the job:

For cold mixes: Mixer + calibrated feeder

For intermediate hot mixes: Mixer + calibrated feeder + dryer

For high-type mixes: Mixer + gradation unit + dryer

Plant with four-bin gradation unit for production of highest type mixes. This multiple-aggregate plant is available in both sizes.

Cold-mix plant, available in both sizes, consists of mixer and calibrated feeder. Dryer and gradation unit may be added later.

Both models offer these advantages:

- Unequaled versatility as described above.
- New hydraulic clamshell discharge gate saves truck time, prevents segregation.
- Transfer pump assures constant head of asphalt for metering pump, eliminates need for asphalt storage tank on mixer.
- Interlocked aggregate and asphalt feeds assure constant, correct proportioning.
- Truck pit no longer required.
- Highly portable plant components allow fast travel between jobs, pay off in more days of operation per season.
- Erection is merely a matter of spotting the units at the plant site and dropping the jacklegs.
- New, easier calibration of single-aggregate and cold-mix plants.

57-12-A

Write for information on these two new flexible high-capacity asphalt plants.

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CONVEYORS . . . LOADERS . . . DITCHERS . . . ASPHALT PAVING EQUIPMENT

To order these helpful booklets check the reply card opposite page 36.

Handbook of Cast Iron Pipes and Fittings

52. Full engineering data on products of the Alabama Pipe Co., including Super De-Lavaud cast iron pressure pipe and pipe fittings, valve boxes and other municipal castings are provided in Pressure Pipe Catalog No. 54, a 196-page publication of Alabama Pipe Co., Anniston, Ala. Weights, dimensions and specifications are clearly indicated in this easy to use reference. Requests for this valuable publication should be accompanied by your business letterhead.

What You Should Know About The Centriline Process

197. The Centriline method for cement mortar lining water mains 16" thru 144" in place to stop leaks, prevent corrosion, increase carrying capacity and decrease pumping costs is fully described in a handsome booklet issued by the Centriline Corp., 140 Cedar St., New York 6, N. Y. Many illustrations and typical case histories show the operation and economies of this process. The Tate process for lining smaller mains is also covered.

Bulletin on Submersible Booster Pump

201. Typical installations, description of unit, standard models, selection tables and the many jobs where this pump can be used are fully described in the bulletin. For full details write Layne & Bowler Pump Co., 2943 Vail Ave., Los Angeles 22, Calif., or check the handy reply card today.

Trenching Equipment Data Conveniently Assembled

212. The entire line of Cleveland trenching and backfilling equipment is now covered in a single bulletin, with material arranged for quick comparison of capacities, specifications and dimensions of all models. Twenty-four action photos graphically illustrate various job applications. Get Bulletin S-120 now for easy review of your trenching equipment needs. Just check the reply card or write to the Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio.

Bell and Spigot Joint Leaks Quickly Repaired

214. Broken water main can quickly be repaired when you have "Skinner-Seal" Bell Joint Clamps on hand. Leaky bell and spigot joints are made lastingly tight with Skinner-Seal Bell Joint Clamps. Get Skinner Catalog GW now—this handsome 48-page book shows how to make every type of pipe repair and covers a complete line of clamps to do the job quickly and easily.

Catalog on Dewatering Pumps

226. Centrifugal and diaphragm pumps for dewatering jobs are described in Catalog DP7 from The Jaeger Machine Co., 550 West Spring St., Columbus 16, O. Models, specifications and performance tables are included. Check the reply card.

Comprehensive Catalog on Gas Chlorinators

234. 20-page Fischer & Porter Catalog 70-15 describes features, construction and application of vacuum-type solution feed gas chlorinators suitable for manual, semi-automatic or fully automatic operation in capacities from 60 to 8,000 lbs. of chlorine per 24 hrs. Check the reply card or write Fischer & Porter Co., 560 Jacksonville Road, Hatboro, Pa., for full details.

Clow Bell-Tite Cast Iron Pipe

280. Laying water mains is easier, faster and more economical with Clow Bell-Tite joint cast iron pipe. Joint employs a single rubber gasket as the only accessory. Complete details available in illustrated literature from James B. Clow & Sons, Inc., P. O. Box 6600-A, Chicago 80, Ill., or check the reply card.

Manual on the Hersey Disc Water Meter

329. Illustrations, descriptions and specifications of Hersey water meters are covered in manual available from Hersey Mfg. Co., 250 Elm St., Dedham, Mass. Size ranges are ⅝"-⅝"x¾"-¾" and 1". Check the reply card.

Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy.

Mueller Copper Water Meter Yokes

242. Copper meter yoke provides a tailor-made setting with fewer joints and fittings and it permits the installation of service lines without placing the meter. Check the reply card or write Mueller Co., Decatur, Ill., for complete information.

Factors to Consider in Elevated Tank Selection

299. Details on the several different types of elevated steel tanks, including capacity ranges, tank dimensions and other factors to be considered in the selection of elevated tanks for modern water storage, plus discussions of new tanks for old towers and foundations are included in Bulletin 101 of the Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Check reply card for your copy.

Quick Review of Water Meters

316. A helpful condensed catalog which covers sizes and types of water meters for every kind of service is available from Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. Each type is illustrated and fully described; specifications and prices are included. Get Bulletin W-800 by checking the reply card.

Helpful Data on Swimming Pools

364. Data on injector nozzles for complete recirculation, fittings for correct drainage and other useful information for pool design are covered in Manual SP issued by Josam Mfg. Co., Michigan City, Ind.

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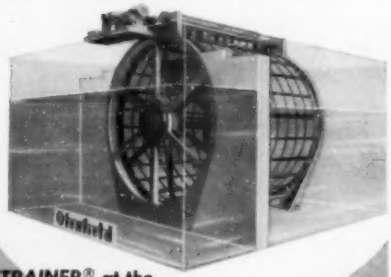

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To order these helpful booklets check the reply card opposite page 36.

Points to Consider in Filter Sand Selection

332. Best operation of rapid sand filters requires filter media which is hard, properly shaped, carefully graded and perfectly clean. Filter sand and gravel which meets these exacting requirements is available on short notice from Northern Gravel Company, Box 307, Muscatine, Iowa.

Testing Water Meters

353. This 40-page catalog is a discussion of fundamentals and a guide to sound practice in meter maintenance. It covers standard specifications of meter accuracy, descriptions of the latest developments in meter testing equipment and many drawings and diagrams. For your copy write The Ford Meter Box Co., Inc., Wabash, Indiana, or check the reply card.

Welded Steel Pipe from 6 to 10 3/4" Diameter

382. High grade butt welded light-weight steel pipe from 8 to 16-gauge in 20, 30 and 40-foot lengths, plain or asphalt coated, with choice of joints. Also available up to 0.188 wall. Check uses for municipal water lines, irrigation, well casings and many other applications. Self explanatory literature from Valley Mfg. Co., Valley, Nebraska.

What You Should Know About Hypochlorination

395. "Hypochlorination of Water" is the name of an informative publication issued by Olin Mathieson Chemical Corp., Industrial Chemicals Div., Baltimore 3, Md. In it there is a discussion of chlorination theory, practice and equipment; control of algae, tastes and odors; and laboratory testing.

Ditcher for Water Pipe Laying

426. A vertical boom, crawler ditcher is described in literature available from Barber-Greene, 400 No. Highland Ave., Aurora, Ill. Specifications and models are fully covered. Check the reply card.

How Your Filter Washing Can Be Improved

368. More effective sand washing with elimination of mud balls and bed cracking with resultant longer filter runs are claimed for the Palmer Filter Red Agitator, described in bulletins issued by Palmer Filter Equipment Co., Erie, Pa. Check the reply card.

Device Used to Regulate Flows of Liquids

396. Valuable data on details of design, capacities, dimensions and typical installations of the Simplex Type S Controller are covered in literature from Simplex Valve & Meter Co., 7 East Orange St., Lancaster, Pa. The unit regulates flow of liquids in filter plants and is used to maintain a uniform rate of filtration through each filter unit. Check the reply card.

Cleaning and Relining Water Pipe the Easy Way

397. Complete facilities for relining cast iron or steel water pipelines in place from 4" to 144" in diameter, with the Spunline (TM), Tate and Centriline Processes offered by Pipe Linings, 2414 E. 223rd St., Wilmington, Calif. For full information on cleaning and relining pipe with only momentary interruption of service, check the reply card.

How to Choose the Right Self-Priming Centrifugal Pump

427. Descriptive folders on the complete line of contractors' pumps have been issued by the Gorman-Rupp Co., Mansfield, Ohio. 2-in. to 10-in models are illustrated, performance tables are shown and pump selection tables are included to assist in choosing the proper pump for different jobs.

Engineering Data on Micro-straining for Clarification of Water Supplies

443. Micro-straining by use of specially woven metallic fabrics clarifies liquids by removal of microscopic-sized suspended solids. A complete discussion of this process and its applications is covered in a 24-page "Micro-Straining Plant" booklet of Glenfield & Kennedy, Inc., 706 North Ave., New Rochelle, N. Y. Check the reply card for your copy.

How to Eliminate Seepage On Construction Projects

472. Labyrinth waterstops are easily installed to provide the answer to the seepage problem and simply form work on all types of construction jobs. Investigate their use for water and sewage plants, reservoirs, swimming pools, etc. For full data check the coupon or write to Water Seals, Inc., 9 So. Clinton St., Chicago 6, Ill.

U. S. Tyton Joint Pipe

490. An eight page booklet on centrifugally cast, Tyton Joint pipe for water or other liquids has been announced. The newly developed Tyton Joint is simple, sturdy and tight. Illustrations show details of joint and method of assembly. Write U. S. Pipe & Foundry Co. Birmingham 2, Ala., or check the reply card.

Copper Sulfate In Control of Microscopic Organisms

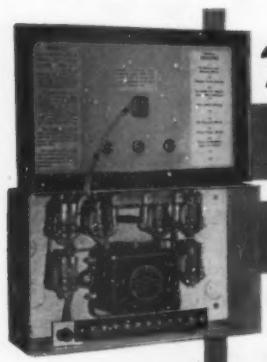
529. This valuable 52-page manual on the use of copper sulfate in the control of microscopic organisms in water supplies is available from Phelps Dodge Refining Corp., 300 Park Ave., New York 22, N. Y. Covered are organisms, odors, methods of using copper sulfate, calculation tables and table showing chemicals required for treatment of different Genera.

Manual on Valves, Fire Hydrants and Accessories

539. A 244-page manual covering Darling valves and fire hydrants in a broad range of types, sizes and constructions is available from Darling Valve & Mfg. Co., Williamsport, Pa. Engineering data, application tips, valve accessories information, reference data on materials, specifications and standards are covered.

Modern Elevated Water Tanks

566. A 16-page bulletin describing 2 types of water storage tanks, the watersphere and the waterspheroid, is available from the Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill. Standard sizes from 25,000 gals. to 500,000 gals. are covered. Check the reply card.



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Dependable Synchro-Start controls provide full automatic starting and stopping according to the operation of any type of pilot switch. Full protection is provided all the time the engine is starting or running. In case of an abnormal condition, such as low oil pressure, overheating, overspeeding, failure to start, etc., the engine will be shut down before any damage can occur and a visual signal will show the exact cause of failure.

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FREE 10 DAY TRIAL—So sure are we of your reception to this magnificent instrument that we offer it FREE for 10 days trial test on your own work sites. You will find that over 40 superior advantages will save you time, concerning this unique instrument.

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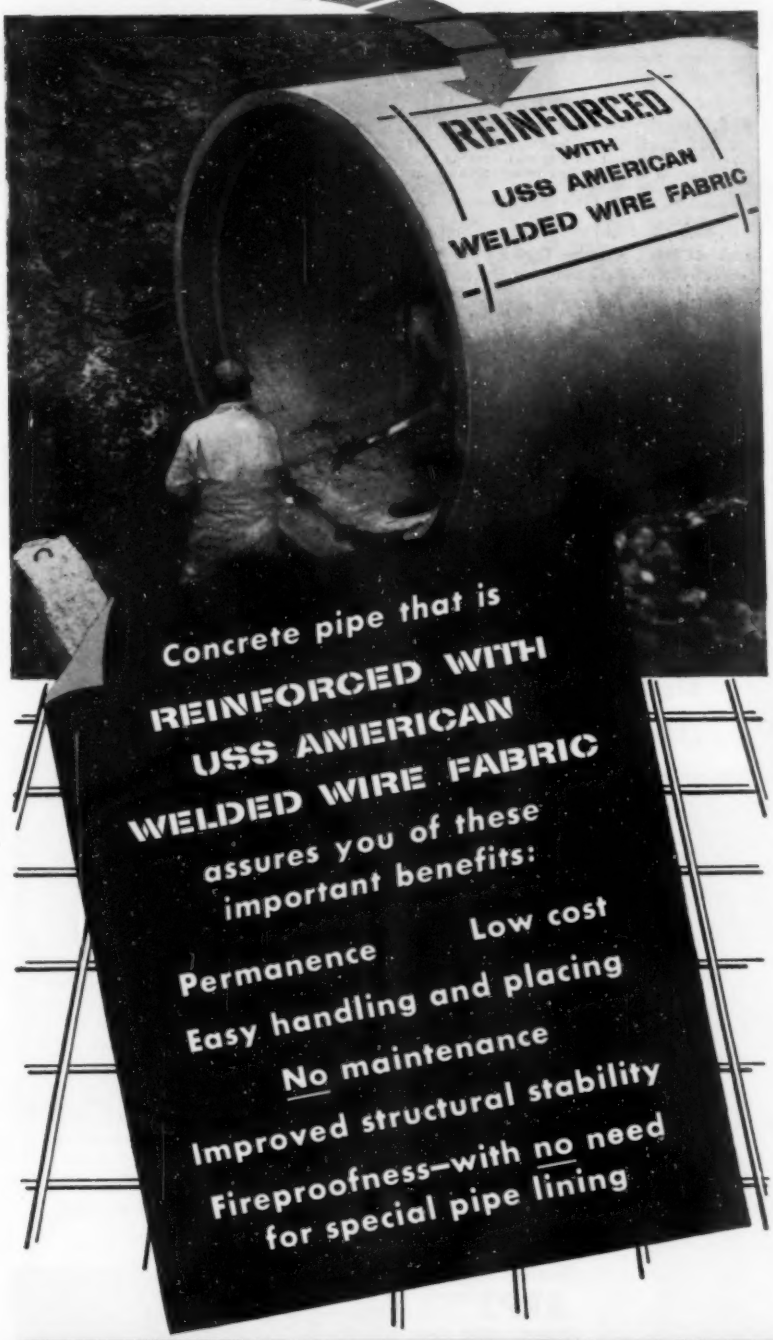

ANY CONCRETE PIPE that is reinforced with welded wire fabric is going to be stronger, more permanent, and easier to maintain than non-reinforced pipe.

BUT TO BE SURE of the *maximum possible* benefits from reinforcement, see that your pipe is reinforced with USS AMERICAN WELDED WIRE FABRIC. American Welded Wire Fabric is precision-made from quality cold-drawn steel wires. The quality of the steel . . . the dependability of the welds . . . the accuracy of wire spacing are all closely controlled to assure you of top performance.

You can get USS American Welded Wire Fabric in the right size and style for any type of sewer or culvert. It comes in circumferential wire sizes up to ½" at 2", 3", and 4" on centers. Write or call for complete information.

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AMERICAN STEEL & WIRE DIVISION
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United States Steel Export Company, New York

USS

UNITED STATES STEEL

To order these helpful booklets check the reply card opposite page 36.

Important Factors in Water Meter Selection

463. Interchangeability of parts is an important advantage that is yours when you use Trident meters. The newest parts fit your oldest Tridents so you modernize when you repair. Get full data on the entire Trident water meter line by checking the reply card or write to Neptune Meter Co., 19 West 50th St., New York 20, N. Y.

Diatomite Filters in Water Filtration

596. A new line of IWF diatomite filters is featured in this 10-page Bulletin 651 by the R. P. Adams Co., Inc., 328 East Park Drive, Buffalo 17, N. Y. The IWF is ideal for medium and small town water supplies and the bulletin provides installation drawings, sectional views and operational sketches.

Data on Mechanical Joint Tapping Valves and Sleeves

605. Eddy mechanical joint tapping valves and sleeves are described in literature available from Eddy Valve. Also described are repair sleeves for cast iron and asbestos cement water mains. Write Eddy Valve Company, Waterford, New York, or circle the reply card for your copy.

Meter For Measuring Large Water Volumes

613. For metering large water volumes in closed conduits ranging in size from 4" to 72", a propeller type low pressure line meter is described in 28-page catalog from Sparling Meter Co., Inc., El Monte, Calif. Check the reply card for data on accuracy and head loss curves, detailed specifications and latest meter data.

Paints For Bridges, Water Tanks & Other Metal Structures

624. Flake silica graphite paints for outdoor metals are described fully in literature from Paint Sales Div., Joseph Dixon Crucible Co., Jersey City 3, N. J. Check the reply card for details on these primer and protective paints.

Swimming Pool Data Book

373. A 52-page book, profusely illustrated, containing data, photographs and prices of every item needed to build a new residential or public pool, or to equip and maintain an existing pool is now available. There is a section on proper pool care and maintenance and detailed descriptions of approved water treatment chemicals. Book is available by checking the reply card or writing to Modern Swimming Pool Co., Inc., 1 Holland Ave., White Plains, New York.

"Packaged" Electric Power For Mobile Installations

656. A well-illustrated 8-page bulletin describing 3 Onan "packaged" power systems is available from D. W. Onan & Sons Inc., Minneapolis 14, Minn. Illustrated are battery charging with AC power, high battery charging output and battery charging only. Check the reply card.

Water Service Hydrants and Outdoor Drinking Fountains

661. Water service hydrants in 4 sizes, ¾", 1", 1½" and 2" and all types of outdoor drinking fountains are described in a well-illustrated, 24-page catalog from The Murdock Mfg. & Supply Co., 426-30 Plum St., Cincinnati 2, O.

All Welded, Field Erected Steel Storage Tanks

689. Tank sizes and tank charts for design and erection of storage tanks are fully covered in bulletin available from Fisher Tank Co., Chester, Pa. Check the reply card for information on welding, testing and maintenance of these tanks.

Ball Joint Pipe For River Crossings

746. A well illustrated 32-page catalog containing instructions for assembly, weights and dimensions, and different methods of installing Molox ball joint pipe for river crossings and submarine service is available from American Cast Iron Pipe Co., P. O. Box 2603. Birmingham 2, Alabama. Check the reply card.

Water Tanks, Reservoirs and Standpipes

631. Data on steel water tanks, reservoirs and standpipes of all capacities are included in literature available from Graver Tank & Mfg. Co., Inc., East Chicago, Ind. These units are fabricated and erected by the company. Check the reply card.

Handbook on Selecting Power For Pumping

694. A 12-page power selection handbook, "Selecting Power For Pumping," has been released by the Advertising Div., Caterpillar Tractor Co., Peoria, Ill. This handbook is especially useful to those who have a pumping operation. It contains a checklist of features necessary for continued dependable operation on pumping jobs. List describes the proper requirements which an engine must have, backing them with illustrations and examples of efficient installations. Check the reply card today.

Flexible Plastic Pipe For Water Distribution

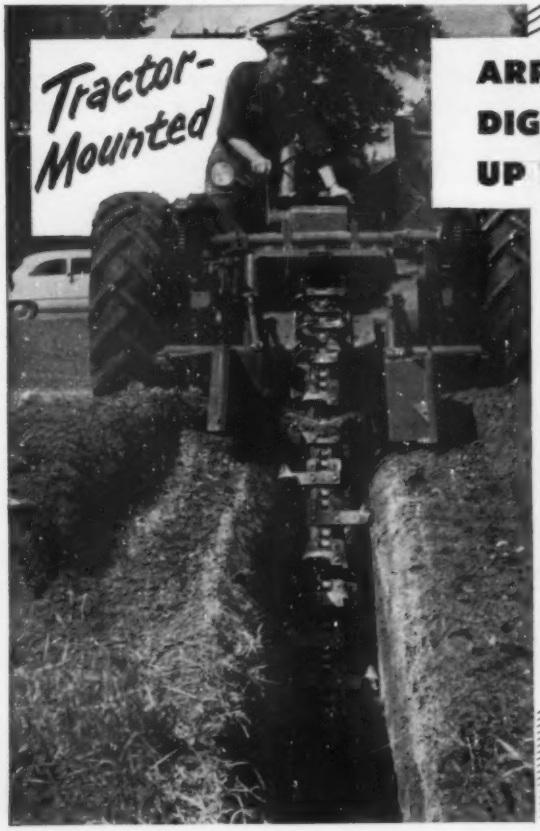
708. A new-type polyethylene resin flexible pipe is described in Catalog No. 401 available from Orangeburg Mfg. Co., Inc., 375 Park Ave., New York 22, N. Y. Fittings, installation, size and weight tables and physical properties are several of the sections covered.

Catalog on Selecting Equipment For Water-and-Waste Treatment

718. Cross-indexed for quick, easy reference to equipment, trade names and applications, this 32-page catalog covers all major equipment in the complete Infilco line. Write for Bulletin 80 to Infilco Inc., P. O. Box 5033, Tucson, Ariz., or check the reply card.

Comprehensive Bulletin on Zeolite Water Softeners

762. Bulletin WC-108 describes Graver zeolite water softeners for municipal water plants, swimming pools and military bases. Check the reply card or write Graver Water Conditioning Co., Div. of Graver Tank & Mfg. Co., Inc., 216 E. 14th St., New York, N Y., for types of zeolites and size data.



ARPS TRENCH HOG DIGS DEEPER—7', DIGS WIDER—20", DIGS FASTER— UP TO 800' PER HOUR

HERE'S the fast, low cost way to handle most any trenching job — drainage ditches, gas lines, water mains, house service lines, septic tank laterals, foundation footings — dozens of other applications. The tractor-mounted Arps Trench Hog gives you big machine performance with a comparatively low initial investment. Has all the features to make tough jobs easy, plus the mobility only a wheel tractor can provide.

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ARPS
CORPORATION
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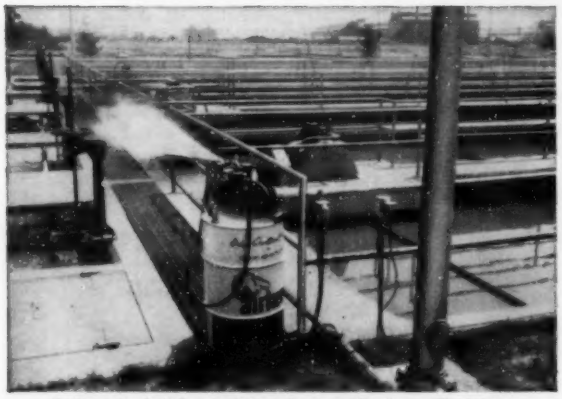
TRENCHERS • HALF-TRACKS
BULL-DOZERS • UTILITY BLADES

Airkem Simplifies Odor Control For Wastes-Disposal Systems



1. Vaporized Airkem solution from application unit counteractants airborne odors from primary settling tank area.

2. Airkem spray heads are located at extreme right and left of activated sludge tank. Time clock controls application heads for evening operation.

3. Drum application unit, simplest form of Airkem installation, is shown here at municipal sludge lagoon.

4. Close-up of applicator head mounted on drum of Airkem liquid. This simple equipment plus an air compressor is the complete installation.

Airkem has developed odor counteractants that will control wastes odors found in every method and stage of treatment. AIRKEM equipment can be installed quickly and easily without interfering with plant operation. Vaporizing AIRKEM liquid odor counteractants is the standard answer for installations throughout the United States. AIRKEM odor counteractants do not enter the system to disturb normal chemical or bacterial action.

Write for free consultation with AIRKEM Field Engineers. They will analyze the odor problem and recommend the most economical and effective solution. Literature on AIRKEM installations is also available. Mail in the coupon today.

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Odor control is a profit builder for trucking companies, oil refineries, smelters, insurance companies, and many other businesses and industries.

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For unobstructed flow...

Rodney Hunt HY-Q Flush Bottom Closure Sluice Gates completely eliminate the problem of debris and silt which accumulate at the sill of conventional gates. Unlike any other design, the HY-Q gate seats on a sill flush with the invert. It has neither a vertical sill wall nor a trough to trap debris and silt, obstruct free flow and prevent proper seating of the gate. Every opening of the gate flushes and clears the seating surface, assuring full, free, unobstructed flow.

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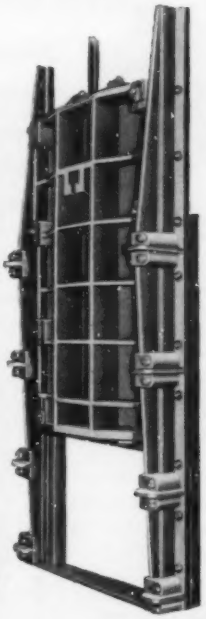
The first basic sluice gate improvement in years features a resilient seal fastened at the bottom of the sliding disc to provide a cushioned closing at the stop bar. This flush bottom closure results in the construction economies of smaller gate sizes, narrower channels and lower channel walls for a given volume of flow . . . and provides unmatched design flexibility for water, sewage treatment and similar projects.

For full design and specification data, write for your copy of Catalog 75.



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SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N.J. Check the reply card and we will forward your request.

Flash Drying and Incineration System

36. Bulletin FD-57 outlines the problem of sewage sludge disposal and includes color diagrams and photographs that explain how the C-E Raymond System works in heat drying and incineration. Check the reply card or write Combustion Engineering, Inc., Raymond Div., 1319 North Branch St., Chicago, Ill., for full details.

A Handbook of Sewer Cleaning Methods and Materials

44. Complete easy-to-follow directions for every type of sewer cleaning operations and the equipment needed for effective cleaning work is covered in a 48-page booklet issued by Flexible Inc., 3786 Durango, Los Angeles 34, Calif. Full details are provided on power cleaning machines, the SeweRodeR, hand tools and all accessories. Water main and culvert cleaning methods are included.

Valuable Bulletin on Rodney Hunt Sluice Gate

61. Sluice gate seats on a resilient rubber seal flush with the bottom of the channel and eliminates bottom wedges and the trough in which they descend. Gives design flexibility in water filtration, sewage treatment and sluices, dam, channel and chamber flow control. For complete details write to Rodney Hunt Machine Co., 82 Lake Street, Orange, Mass. for Bulletin 75, or check the reply card.

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers.

Mechanical Joint Principle Applied to Sewer Pipe

101. The Amvit joint forms a tight compression seal between bell and spigot rings, prevents infiltration and stops root intrusion. Get data on Amvit jointed vitrified clay pipe from American Vitrified Products Co., Cleveland, Ohio. Check the reply card.

Complete Line of Premolded Expansion Joint Fillers

140. Expansion joint fillers for use in expansion joints in concrete are described in literature from Servicised Products Corp., 6051 West 65th St., Chicago 38, Ill. Check the reply card.

Manual on Sewer Structures

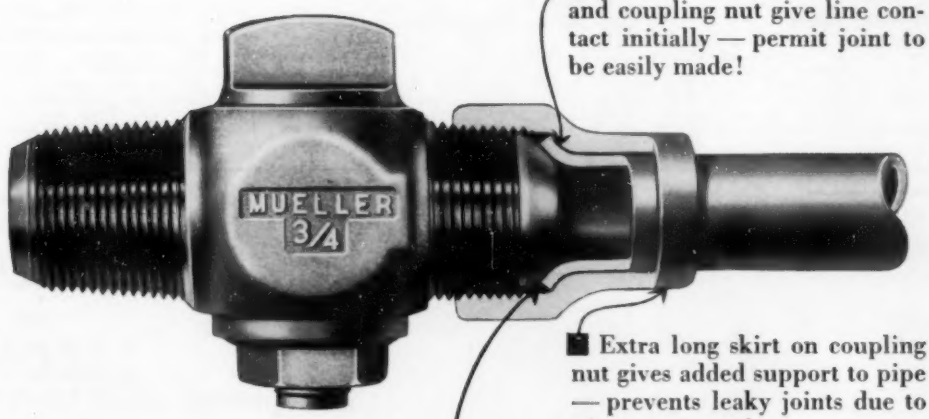
178. This is a 48-page manual on installation design, reference data and graphs showing discharge of pipe based on Manning's formulas. Also such subjects as structural durability, material durability; selection of structures; factors influencing capacity; joints and fittings; and linings for failing sewers are covered. Copies of Manual CMS-7456 are available from the Product Information Service, Armco Drainage & Metal Products, Inc., Middletown, Ohio, or by checking the reply card.

Centrifugal and Turbine Type Pumps For Water and Sewage Plants

321. Turbine-type pumps, close or flexible couple drive, side suction centrifugal pumps and mixed flow pumps are described in Catalog M available from Aurora Pump Div., The New York Air Brake Co., Loucks at Dearborn, Aurora, Ill. Included is a pump selection guide.

MUELLER® CORPORATION STOPS

. . . *with* MUELLER
copper service pipe connection



■ Convex surfaces on stop body and coupling nut give line contact initially — permit joint to be easily made!

■ Extra long skirt on coupling nut gives added support to pipe — prevents leaky joints due to pipe movement!

Sizes from ½" through 2"

■ Opposed convex surfaces do not compress end of flange — give greater resistance to pipe pulling out.

See the new, automatic
Mueller CL-12 *Drilling Machine!*

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MUELLER CO.
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Factories at: Decatur, Chattanooga, Los Angeles; In Canada, Mueller, Limited, Sarnia, Ontario

To order these helpful booklets check the reply card opposite page 36.

Complete Story of Rubber as a Coupling Medium in Pipelines

295. "Joint Enterprise", a booklet describing Tylox rubber joints for coupling pipe used in sewerage, drainage and waterworks projects is now available from Hamilton Kent Manufacturing Co., 7 West Grant St., Kent, Ohio. The booklet also contains illustrated case histories of Tylox-Jointed installations, and suggestions to assist engineer in specifying Tylox joints for both tongue and groove, and bell and spigot pipe. Check the reply card.

Getting Improved Sludge Dewatering With Non-Clogging Vacuum Filters

425. Latest information on the Komline-Sanderson "Coilfilter," which features non-clogging, permanent filter media to obtain constant output and low operating cost is presented in illustrated Bulletin No. 106 by the Komline-Sanderson Engineering Corp., Peapack, N. J. Be sure to investigate this improved method of sludge dewatering. Check the reply card today.

Use The Reply Card

Portable, Standby Or Continuous Power

440. Generators and power plants for emergency, portable continuous power are described fully in literature available from Katolight Corporation, Box 89-107, Mankato, Minnesota. Information on motor generator sets, high frequency changers and independent generators up to 400 K. W. is included.

Vitrified Clay Floor System For Trickling Filters

452. The IMCO two unit floor is noted for its mechanical strength, simplicity of construction and large percentage openings for aeration. The units are self spacing and easily set in place. Check the reply card or write Industrial Materials Co., Somerset St. and Trenton Ave., Philadelphia 34, Pa., for complete catalog.

Digester Mixer Uses Sludge Gas

474. Gaslifter digester circulator-mixer is described in Bulletin 25-S-91 available from Walker Process Equipment Inc, 840 N. Russel Ave., Aurora, Ill. The unit utilizes the "air-lift" principle and operates on compressed digester gas. Check the reply card for complete specifications.

Underground Pumping Stations, Complete Package Units

522. Pre-fabricated automatic underground pumping stations that are completely assembled for quick, economical installation are described fully in literature available from Schmieg Industries, Inc., Pumping Station Div., 23930 Sherwood, Center Line, Mich. Generous access space between pumps and accessible sump pump location are a few features.

Pressure Operated Sump Controls Used in Pumping Stations

525. Literature is available from Healy-Ruff Co., 2255 University Ave., St. Paul 14, Minn., describing controls used in the control of liquid level in sumps and wet wells and single and multi-pump controls for pumping stations and sewage plants. Check the reply card.

Small Unit Sewage Treatment For 20 to 5000 People

568. Bulletin 135 describes the Rated-Aeration process, a low cost, odorless, trouble-free sewage treatment process. Check the reply card or write Chicago Pump Co., 622 Diversey Parkway, Chicago 14, Ill.

Slide Rule For Chemical Feed Calculations

627. A very handy chemical feed calculator is available from Industrial Chemical Sales Division, West Virginia Pulp and Paper Co., 230 Park Ave., New York 17, N. Y. Pounds per million gallons, grains per gallon and grains per gallon of CaO from lime are several of the calculations that can be made. Check the reply card today.

V-Notch Chlorinators For Water and Sewage Plants

590. Bulletins on the Series A-711 and the Series A-712 chlorinators are available from Wallace & Tiernan Inc., Box 178, Newark, N. J. Covered in the literature are design features that include operation, installation and maintenance. Simplified flow diagrams in color are included showing the operation of the units. Class, capacities, feed ranges and electrical requirements are described in the technical data section. For your copies, check the reply card.

Catalog on Steel Grating

665. New ideas in flooring, walkways, stair treads, platforms and shelving are covered in Catalog 2527 available from Blaw-Knox Co., Dept. W., Pittsburgh 38, Pa. Check the reply card for information on choice of cross bar and bearing bar designs and spacings.

Reinforced Concrete Pipe For Culverts and Sewers

672. Elliptical Lo-Hed and Hi-Hed pipes, round pipe and flat base pipe are described fully in literature from American-Marietta Co., Concrete Products Div., 101 East Ontario St., Chicago 11, Ill. Headwall details, discharge curves, hydraulic capacity tables and hydraulic properties are included. Check the reply card.

Catalogs on Diesel, Dual-Fuel, Natural and Sewerage Gas Engines

679. Heavy duty diesel, dual-fuel, natural and sewerage gas engines for continuous stationary service are described in literature available from Chicago Pneumatic Tool Co., 8 East 44th St., New York 17, N. Y. Check the reply card for details on 3, 4, 5, 6 and 8 cylinder models and in capacities from 120 to 3000 hp.

New Concept in Measuring Flow Through Parshall Flumes

702. Advantages, operation, construction and special features of the Type "ML" meter for accurate measurements of flow are covered in Bulletin No. 1200 available from Burgess-Manning Co., Penn Instrumenta Div., 4110 Haverford Ave., Philadelphia 4, Pa. Design and capacity tables are included.

Modern quality incineration at low cost

Approximately $1400 per ton — including furnaces, building and chimney.

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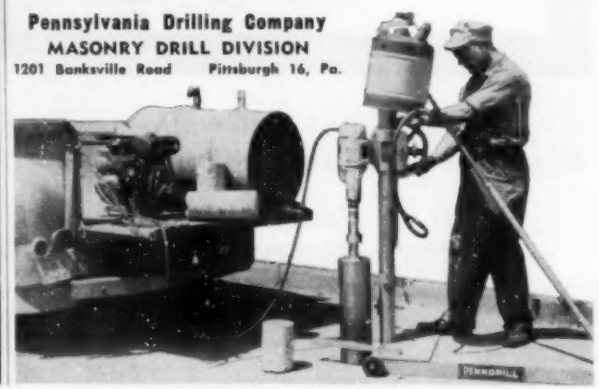


County road duty tests operator and machine

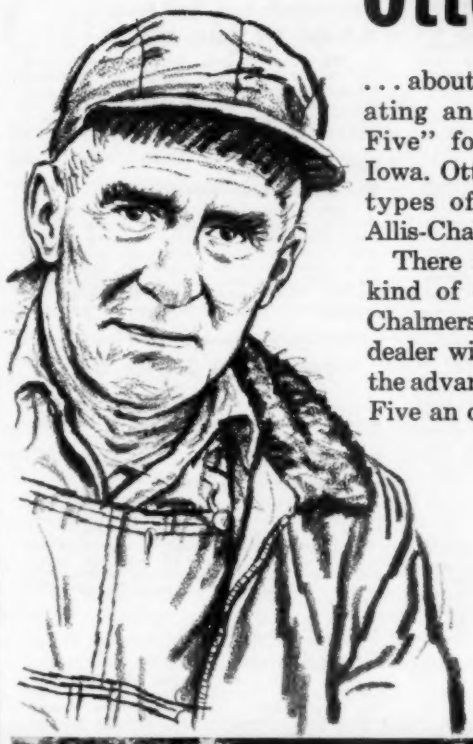
Otto Nikoley, Alta, Iowa, works full time maintaining roads for Buena Vista County.

Eight months a year, he and the Allis-Chalmers Forty Five motor grader work a program of finishing dirt and gravel roads. An average of three passes is all that's required to finish most of his jobs. During winter months, the grader is still productive. Equipped with snowplow, the machine is busy keeping roads open and traffic on the move.

Otto and the Forty Five work well together. There's plenty of power at hand to do the job. The Forty Five is easy operating, too. The platform is roomy and the deck is clear. Visibility is excellent all around, sitting or standing. And the blade's controls can't kick back. When Otto moves the lever, toggle engages or releases clutches surely, without wrist-snapping backlash.

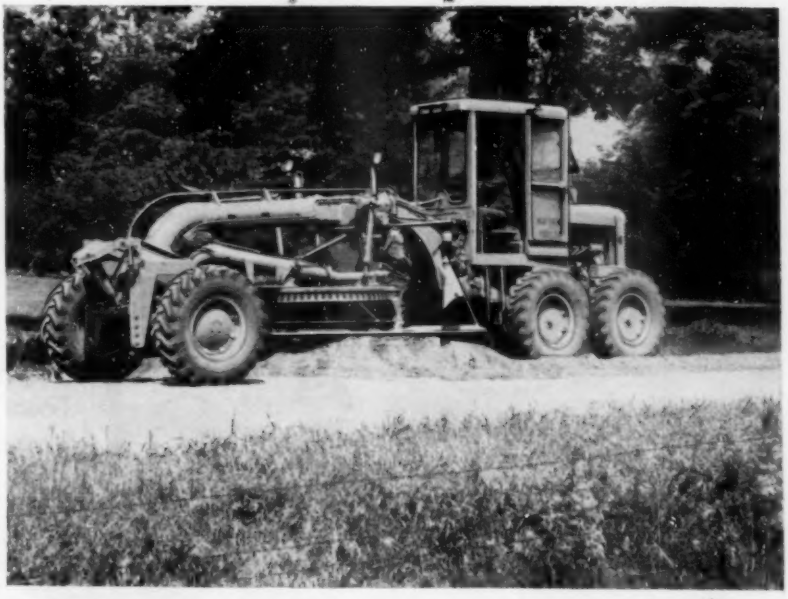
Put your operators on Allis-Chalmers motor graders. More and more counties are stretching tax dollars by doing it. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wis.

Ask Operator Otto Nikoley



. . . about motor graders. He's operating an Allis-Chalmers "Forty Five" for Buena Vista County, Iowa. Otto will tell you that of all types of graders, his choice is Allis-Chalmers every time.

There are good reasons for this kind of enthusiasm. Your Allis-Chalmers construction machinery dealer will be glad to demonstrate the advantages that make the Forty Five an operator's favorite.



FORTY FIVE
120 brake hp • 6 speeds forward • 3 speeds reverse • 23,800 lb

Look ahead...*move ahead*
...and stay ahead with **ALLIS-CHALMERS**

To order these helpful booklets check the reply card opposite page 36.

STREETS AND HIGHWAYS

Levels Sidewalks and Curbs Quickly and Easily

29. How the Mud-Jack Method for raising concrete curb, gutter, walks, streets and factory floors solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a 16 page catalog by Koehring Division, 3026 W. Concordia Ave., Milwaukee 16, Wis. Check the reply card.

1,001 Profitable Uses For Holmes-Owen Loader

39. The addition of a Holmes-Owen Loader to your dump truck converts it into a complete digging and loading unit that enables one man to load, haul and dump. Illustrated folder shows how this self-loading unit with hydraulic crowding action can be a real time and labor saver for the municipality or contractor. Check the handy reply card for full data. Ernest Holmes Co., Chattanooga, Tenn.

A Street Sweeper For Every Sweeping Need

158. A new catalog containing eight pages of illustrated information on street sweeping with the Mobil Sweeper, motor pickup type street sweeper, is just off the press. It is used on streets, highways, airports, parks, parking areas and other paved areas. For your copy write Mobil Sweeper Div. of the Conveyor Co., 3260 E. Slauson Ave., Los Angeles 58, Calif., or check the reply card.

Better Highways Through Salt-Soil Stabilization

162. Practical information for the men who build, repair and maintain our highways is provided in two bulletins issued by the International Salt Co., Inc., Scranton, Pa. General principles of salt-soil stabilization, applications, plant mix and road mix are described. Check the reply card for your copies.

Concrete Pavement Manual Offered

171. Details of design and principles of concrete pavement construction are presented in a 78-page manual published by the Portland Cement Assn., 33 W. Grand Ave., Chicago 10, Ill. Data from many sources is summarized in convenient form to help design and construction engineers. Check the coupon for your copy.

Bridge Concreting, Its Problems and Solutions

390. A 16-page catalog illustrating the concreting problems involved in bridge construction is available from The Master Builders Co., Cleveland 3, Ohio. The catalog covers concreting of piers and bridge decks for highway and railway bridges, and includes discussion of hot and cold weather concreting, the use of lightweight aggregate in bridge work; and placing and finishing problems encountered in bridge work. Check the reply card for Catalog MBR-P-11.

Hydraulic Highway Mowers For All Makes of Tractors

259. Mowers for roadside maintenance that are available for right, left or both side installation are described in catalog from A. C. Anderson, Inc., Wildwood, N. J. Specifications and models are fully covered. Check the reply card.

New Reflectorized Sign Faces Refurbish Old Traffic Signs

292. Get complete details on new "EZ-On" traffic sign faces ready for immediate shipments. Reflectorized faces cost only a fraction as much as new signs and are easily attached to existing traffic signs. Grace Sign & Mfg. Co., St. Louis 18, Mo.

Sign Catalog Has Latest Specifications

417. Detailed information on all classifications of standard signs for traffic control, street identification and other purposes together with a complete line of accessories is presented in a convenient Sign Manual by Lyle Signs, Inc., 2731 University Ave. S. E., Minneapolis 14, Minn. Get Catalog B-55 for most recent data and specifications on U. S. Standard signs.

For Prompt Service Use The Reply Card

Literature on Asphalt and Aggregate Spreaders

431. Aggregate and asphalt spreaders are fully described in literature available from Good Roads Machinery Corp., Minerva, Ohio. The "Odell" and "Handy" speakers can be hitched to any standard dump truck and can spread asphalt, gravel, clay, limestone for highway construction and maintenance. For full details check the reply card.

4-Wheel Drive Tractor Loaders

434. A 16-page Catalog, No. 1033-5-57, describing the "Tracto-Loader Line" of front end wheel loaders is available from Tractomotive Corp., Deerfield, Ill. Covered are the five models that are in production.

Catalog on Transits, Levels and Surveying Equipment

435. Warren-Knight field equipment for surveying is covered in a 26-page well illustrated catalog. Specifications, models and prices are included. Check the reply card or write Warren-Knight, 136 North 12th St., Philadelphia.

Ultra-Clean Sweeping For Streets, Yards and Airports

499. A new approach to extra-clean sweeping is described in a 4-page illustrated Bulletin (No. 85.55) issued by the G. H. Tennant Co., 755 N. Lilac Drive, Minneapolis 22, Minn. Described is a 7'4" path sweeper that eliminates the use of water for dust control. Check the reply card.

Advanced Tractor Design Gives Better Performance

399. The Ford Tractor offers 4-wheel stability, built-in hydraulic system, power take-off, as well as greater power, performance and economy. A complete booklet describes five tractor models in two power series, showing the latest in advanced tractor design and including many applications of equipment for saving time and money. For your copy check the reply card or write Tractor and Implement Division, Ford Motor Co., Birmingham, Mich.

Pre-Assembled Dowel Units For Highway and Airport Construction

537. Laclede dowel assemblies for expansion, contraction and construction joints are precision welded into one unit and are maintained in rigid alinement. For full details write Laclede Steel Co., St. Louis, Mo., or check the reply card today.

Reflectorized White or Yellow Crosswalk Markings

578. Crosswalk markings of Perma-Line, the quick setting line that is easily applied, trouble-free, economical, and which outlasts paint 4 to 6 times, is described in literature of the Veon Chemical Corporation, 22-09 Bridge Plaza North, Long Island City 1, N.Y. Available in reflectorized white or yellow. Tests under your local conditions are invited.

Catalog on John Deere Tractors and Equipment

588. Information and specifications on the John Deere "420" crawler and wheel-type industrial tractors are fully covered in catalog from Deere & Co., 3300 River Drive, Moline, Ill. Attachments such as snow plow blades, rear-mounted blades, mowers and angling dozers are described. Check the reply card.

Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y., or can be obtained by checking the reply card.

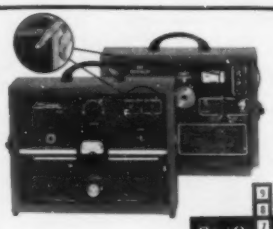
Construction Methods for Salt Stabilized Roads

609. A comprehensive booklet showing modern methods of salt stabilization is available from the Morton Salt Co., 120 So. LaSalle St., Chicago 3, Ill. Stabilized secondary roads, base courses and shoulders are discussed and all equipment and construction methods are covered. Just check the reply card for your copy.

Warn Lock-O-Matic Hubs Manual

618. Warn Hubs make 4-wheel drive more useful, because they make it into a "free-wheeling" 2-wheel drive, as well as a 4-wheel drive. The Lock-O-matic hubs reduce front end wear, engine load and gear whine. Check the reply card or write Warn Mfg. Co., Riverton Box 6064, Seattle 88, Wash.

PIPE LINE ENGINEERS!



Why Take Unnecessary Chances of Breaking Buried Pipes, Cables!

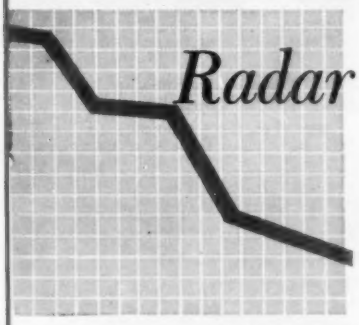
Send Coupon for Details ►

ONE ACCIDENT WILL PAY FOR THIS LONG-LIFE "DETECTRON" PIPE DETECTOR

Computer-Measurements Corp.
5528 Vineland Ave. Dept. 55 D
North Hollywood, California
Please send complete details on the Detectron "505" Pipe Detector TODAY.

NAME .....
COMPANY or CITY .....
ADDRESS .....
CITY .....STATE .....

NEWSPAPERS REPORT:



Radar Cuts Highway Death Toll

Results provide the best endorsement of Electro-Matic® Speed Meters. Here's how a few newspapers have reported those results to readers when Speed Meters were used locally:

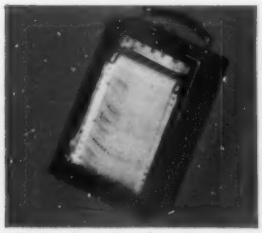
"Radar Cuts road death toll 25%" — *Long Beach, Calif., Ind. Press Telegram.* "Accidents' injuries reduced 22%" — *Cleveland Press.* "Number of cars exceeding 50 miles an hour reduced 50%" — *N.Y. Journal-American.* "Police and court officials feel that radar is superior to other types of speed enforcement because it virtually eliminates human errors." — *Arcadia, Calif., Tribune & News.* "Reduces local traffic deaths by 28%" — *Pasadena, Calif., Star News.* "Psychological effect like magic" — *Pittsburgh Sun-Telegraph.* "Psychological effect of radar has reduced speeding, and that, in turn, has reduced the death toll" — *Belleville, Ill., Advocate.* "Radar machines cost money. But so do funerals. In the long run radar is cheaper." — *Houston Press.* "Nation's top traffic policeman is radar; use is increasing" — *Greenwood, S.C., Index-Journal.*

"Traffic Toll Drop Credited to Radar" — *Buffalo, N.Y., Courier-Express.* "Radar cutting death toll on highways" — *Bridgeport, Conn., Sunday Post.* "Grand Jury urges radar speed control" — *San Jose, Calif., Mercury.* "We've saved 6 lives! Give radar a hand" — *Houston Press.* "Radar credited in accident decrease" — *Lubbock, Texas, Avalanche-Journal.* "Since use of radar highway deaths drop" — *Wichita Falls, Texas, Daily Times.* "Oregon motorists favor the use of radar in speed detection by ratio of three to one" — *Eugene, Oregon, Register Guard.* "Most effective means of stopping slaughter on the highways" — *Atlantic City, N.J., Press.*

To help stop the slaughter on *your* highways, investigate the advantages of Radar — a proved scientific means of speed detection.

Highly versatile, Electro-Matic Speed Meter can be mounted permanently on vehicle, or used as portable equipment.

Radar is most accepted method of conducting speed studies used in determining reasonable speed limits.



Recorder provides permanent record.

For details, write for Bulletin R-112.

TRAFFIC ACTUATED ®

AUTOMATIC SIGNAL DIVISION

EASTERN INDUSTRIES, INC. • REGENT STREET, E. NORWALK, CONNECTICUT

To order these helpful booklets check the reply card opposite page 36.

Crezon Plywood Signs Have Long Life Expectancy

641. Crezon overlaid plywood signs are described fully in literature available from Crown Zellerbach, San Francisco 19, Calif. Material is strong and rigid, resists bending or tearing loose from the pole and there's neither checking nor blistering from heat or freezes.

Catalog on Road Rollers and Compaction Equipment

667. Two and 3-axle tandem rollers, 3-wheel variable weight rollers and the Kompactor are covered in this catalog from Buffalo-Springfield Roller Co., Springfield, Ohio. Specifications, models and features are included. Check the reply card today.

Use The Reply Card

Reflective Pavement Marking

685. Centerlite reflective compound has the beads already in the mixture and you apply the stripe in one pass on the pavement. Check the reply card or write Minnesota Mining & Mfg. Co., Dept. QV-28, St. Paul 6, Minn., for full details.

Literature on Reflective Glass Beads

690. Glass beads for traffic signs and street name signs are described in literature available from Flex-O-Lite Mfg. Corp., 8305 Flex-O-Lite Drive, P. O. Box 3066 (Affton Br.), St. Louis 23, Mo. Beads can be used on white and yellow signs. Check the reply card.

Ford V-8 Trucks Have Electric Fuel Pumps

765. Three all-new Ford super duty V-8's, and ten all-new extra duty heavy duty truck series for maintenance and construction depts. are covered in catalog from Ford Motor Co., Truck Div., Dearborn, Mich. Check the reply card today.

REFUSE COLLECTION AND DISPOSAL

New Roto-Pac Features Speed Refuse Collection

50. Features of the Roto-Pac refuse collection unit, which include automatic continuous loading and packing, with increased power to provide for larger loads in the same size body, are described in bulletins issued by City Tank Corp., 53-09 97th Pl., Corona, L. I. Check the reply card now to learn how your collection problems can be eased.

Developments in Refuse Collection

119. The "Dempster-Dumpmaster" system for refuse collection combines the advantages of detachable containers for bulk collection, convenient front-end loading and compaction in a sealed body. Be sure to investigate the application of this system to your collection needs. Complete data offered by Dempster Bros., Knoxville 7, Tenn. Check the reply card today.

Refuse and Garbage Packer Bodies

241. Ranging in capacity from 12 to 24 cu. yds., the M-B packers have a 30 second compaction cycle and have large side loading doors. Write M-B Corp., New Holstein, Wisc., or check the reply card for bulletin on specifications.

General Specifications for Refuse and Garbage Trailers

251. Two bulletins, one on the Pak-Mor 38 cu. yd. tandem axle trailer unit and the other on the Pak-Mor 32 cu. yd. trailer for use with Model GRD Dempster are available from Pak-Mor Manufacturing Co., Box 6147, San Antonio, Texas. General specifications, power train, operating procedures, maintenance and lubrication and other helpful information are included.

How to Construct A Sanitary Fill

331. A new 12-page booklet which tells the most efficient method of sanitary fill construction and furnishes complete information on planning and operation is now available from Drott Mfg. Corp., Milwaukee 15, Wis. Get your copy by checking the reply card; you'll find this booklet both interesting and valuable.

What You Should Know About Refuse Incinerators

362. Two helpful bulletins tell what you should know about low cost refuse incineration for the small community and for larger cities. Your questions on mechanical stoking, burning rates and operating problems are discussed. Get Bulletins 217 and 223 from Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. Just check the reply card.

Methods and Benefits of Sanitary Landfill

409. Information on Sanitary landfill methods, organization and necessary equipment with which to carry out the job is available from the Construction Machinery Div., Allis-Chalmers Mfg. Co., Milwaukee, Wis. Check the reply card today.

Incinerators For All Services in Incinerating Wastes

577. Incinerators for municipalities, office buildings, institutions and warehouses are described in Bulletin No. 12 available from Pyro Incinerator Corp., 48-11 Thirty-First Ave., Long Island City 3, N. Y. Check the reply card for complete specifications.

Modern Methods in Sanitary Landfills

699. Up-to-date data, pictures and explanation of sanitary landfill, its methods and equipment are covered in this valuable bulletin from The Oliver Corp., 19300 Euclid Ave., Cleveland 17, O. Check the reply card for information on satisfactory garbage and refuse disposal methods.

Check Diamond Chemicals before budgeting new mowers

With DIAMOND herbicides on the job, there may be years more life in present mowing equipment. Three-year tests just completed prove that a combination of chemical weed killers and brush killers applied three times a year drastically cuts the number of mowings required. Not only does this bring costs into line, it also controls weeds and brush 30 feet or more back from the roadway.

And once control is established, sprayings can be less frequent, costs even lower.

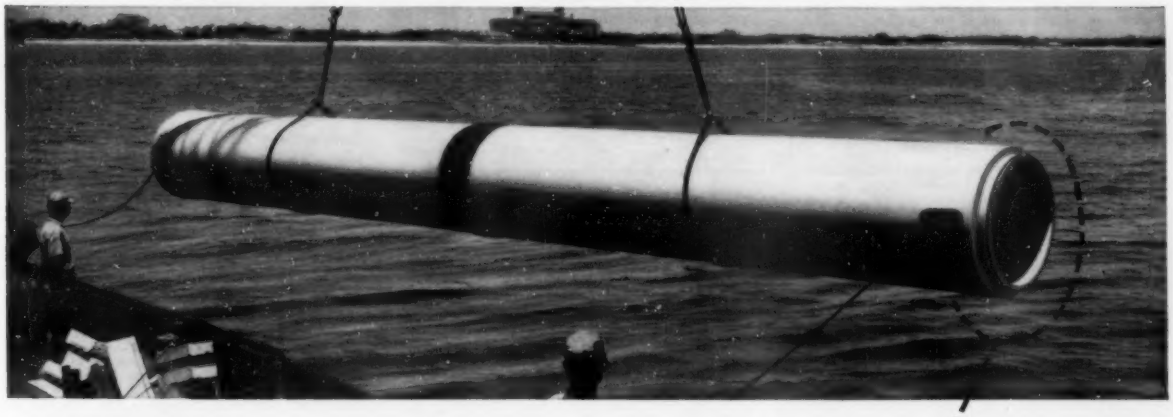
Whether you plan to operate your own spray equipment or employ contract sprayers, it will pay you to check with DIAMOND on what to use and when to use it. We'll gladly have a technical man call on you. Write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

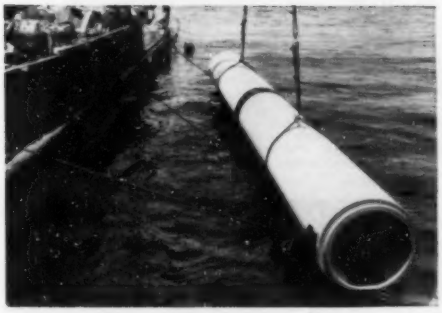
Diamond Chemicals

Photo by The Davey Tree Expert Company

LONG

LENGTH CONCRETE PIPE





Subaqueous ocean outfall line at Palm Beach, Florida. Engineer: Norman C. Schmid & Assoc., Palm Beach. Contractor: Powell Bros. Co. Inc., Ft. Lauderdale.

with TIGHT STEEL and RUBBER AMSEAL® JOINTS

Whether you want to keep water in or out—or both—American-Marietta long length concrete pipe with Amseal joints will do it better at less cost. In fact, the Engineer on the above job says, "The original design called for 24″ diameter pipe of another type but 30″ Amseal Subaqueous Pipe proved more economical."

The longer lengths enable a contractor to install 32 feet of pipe—often 64 feet—at a time. This means less handling and joint making . . . improved flow capacity through use of fewer joints.

The "pressure proven" rubber and steel Amseal joint provides a flexible but positive water-tight seal against costly infiltration or leakage. For underwater work subaqueous connections are provided to simplify installation. Write our technical staff for assistance with your pipe problems.

Another example of
PROGRESS IN CONCRETE

Trade-Mark Reg. U.S. Pat. Off.

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

To order these helpful booklets check the reply card opposite page 36.

CONSTRUCTION EQUIPMENT AND MATERIALS

What You Should Know About Air-Placed Concrete

67. For a detailed explanation of the principle of "gunned" or "air-placed" concrete and description of the improved Model 750 and 1250 Bondactors, be sure to get your copy of Form 553 from Air Placement Equipment Co., 1011 W. 24th St., Kansas City 8, Mo. Check the reply card today.

Design Manual on Complete Structural Systems

100. Manual contains technical information relative to Stran-Steels line of joists, studs, channels, ribbed decking and metal curtain walls. It is well illustrated and contains several pages of loading tables. For this valuable Manual write Stran-Steel Corp., Detroit 29, Mich., or check the reply card today.

Handbook of Castings For All Public Works Construction

220. Every type of construction casting needed by engineers and contractors in the public works field will be found in a 136-page catalog issued by Neenah Foundry Co., Neenah, Wis. Detailed illustrations and complete tables of dimensions will help the designer and materials buyer.

Drilling Machine For Concrete

221. The Truco diamond drilling machine is described in literature available from Truco Swivel Div., Wheel Trueing Tool Co., 15-3200 W. Davison Ave., Detroit 38, Mich. Unit will cut reinforced or plain concrete. Check the reply card.

Useful Attachments for "Payloader" Tractor Shovels

95. Increased versatility for Hough "Payloader" tractor shovels is made possible by the various attachments described in literature of the Frank G. Hough Co., 761 Seventh St., Libertyville, Ill. Illustrated and described are rotary "V" and trip-blade snow plows, hydraulic backhoe, back-filler blade, pickup sweeper, scarifier teeth, winches, etc. Check the reply card today and full details will be sent.

Check List for Successful Earthmoving Bids

147. Valuable information for the earthmoving contractor and for the engineer who must estimate earthmoving costs is provided in a new two-color illustrated booklet issued by Caterpillar Tractor Co., Peoria, Ill. A convenient check list is included to help select the proper equipment for the job. Check the reply card to get Form No. DE502.

For Prompt Service Use The Reply Card

Manual on Steel and Wire for Road Building

337. Design data on wire fabric for concrete pavements, joint data, guardrail design standards, steel and wire for concrete pipe and reinforced bituminous concrete design are some of the sections covered. Check the reply card or write American Steel & Wire Div. of United States Steel Corp., Cleveland 13, Ohio. for this valuable manual.

Catalog on Utility Bodies and Equipment

360. General service bodies, line construction bodies, aerial equipment, winch and derrick equipment and trailers are the units covered in this catalog. For design, dimensions, illustrations and descriptions check the reply card or write McCabe-Powers Auto Body Co., 5900 N Broadway, St. Louis 15, Mo.

Hydraulic Backhoe For Many Makes of Tractors

456. A backhoe that digs sewer systems, culverts, water mains, foundations and ditches is described fully in literature from Henry Mfg. Co., Inc., 1700 N. Clay St., Topeka, Kans. Check the reply card for specifications and details.

IHC Crawler Tractors For Highway Construction

491. Information on the new International TD-6, TD-9, TD-14 and TD-18 diesel crawler tractors is contained in 8-page, 2-color booklets available from Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. Mechanical features and specifications, engine power, and operation are fully covered.

Tandem Rollers With Torque Converter

524. Specifications, types, models and features of Huber-Warco tandem rollers are covered in Bulletin HWT-525 available from Huber-Warco Co., Marion, O. Check the reply card for this complete bulletin on rollers.

Agent For Improving Adhesion Between Old and New Concrete

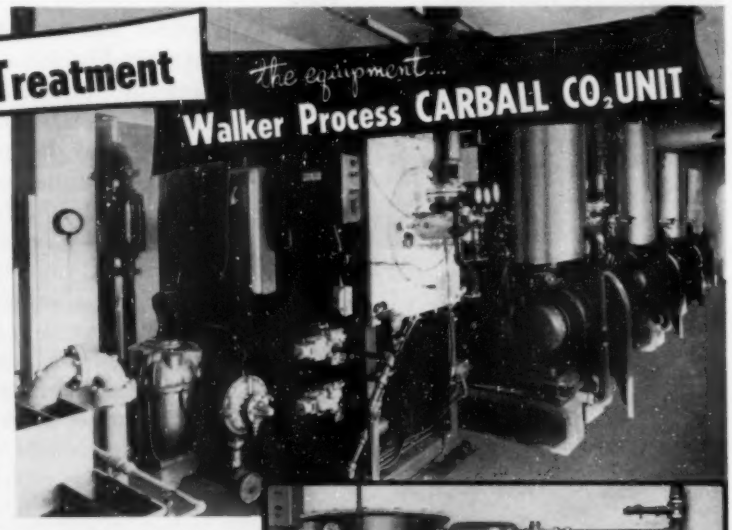
530. Thorobond liquid bonding agent for improving adhesion of new concrete to old concrete walls, floors and ceilings is described in literature available from Standard Dry Wall Products, Inc., New Eagle, Pa. Check the reply card for information on typical uses and methods of application.

Construction Guide For Engineers and Builders

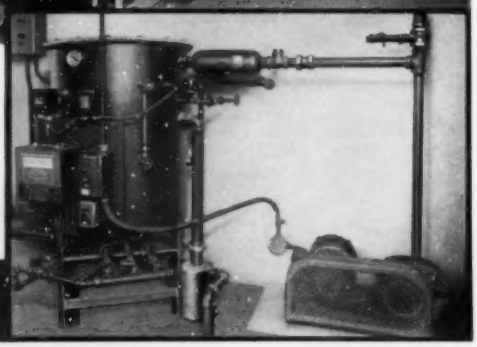
669. A 34-page four sectioned construction guide containing full-page structural drawings that provide basic information on types, grades and applications of fir plywood for engineers and builders has been released by Douglas Fir Plywood Association, Tacoma 2, Wash. Check the reply card for data on floor construction, single and double wall construction and roof construction.

the process... Carbonation--Water Treatment

CARBALL CO_2 UNIT



Four size 4 Carballs at Kansas City, Mo. burn either gas or oil to produce max. of 40,000 lbs. CO_2/day. Size "O" unit at right produces 570 lbs. CO_2/day for Jefferson, Iowa Water Plant.



Walker Process now offers carbonation units for all lime softening plants from the very small to the largest. Sizes range from the new "OO" unit with minimum capacity of 55 lbs. CO_2/day to the No. 4 at maximum output of 10,000 lbs. CO_2/day. Engineers can readily provide an entire carbonation system by simply specifying the appropriate size CARBALL in combination with Walker Process SPARJER diffusers . . . . . assuring

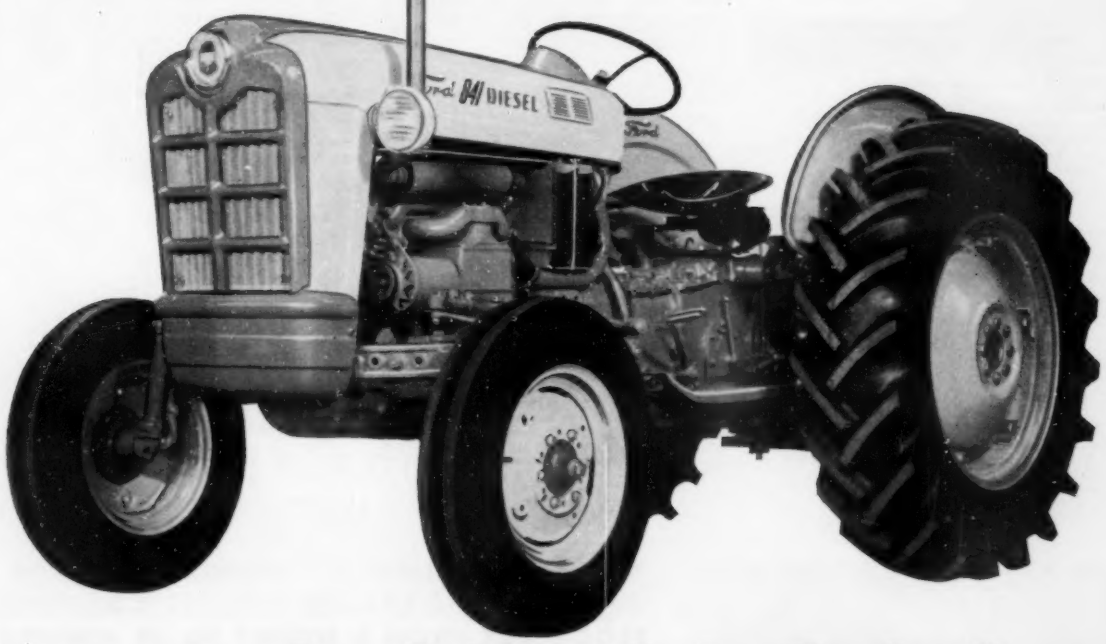
100% Combustion • Economical Operation • Unique Absorption Method
50% More CO_2 • Clean, Tasteless Gas • Factory Tested Package System

Write for bulletins 7W83 - 7W85 and 7W88

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.
FACTORY • ENGINEERING OFFICES • LABORATORIES
AURORA ILLINOIS

NEW Ford Diesel Tractors



Lowest priced diesels in their class!

Now from Ford—traditional leader in the industrial field—comes a new line of diesel tractors which will combine greater operating economies through thrifty diesel power with all the time-tested performance features of Ford's gasoline tractors! Four great new models ranging from a Special Utility Model through fully equipped models with choice of four or five speed transmissions, or an auxiliary transmission giving 12-speed mobility, and standard or "live" power take-off. All front and rear-mounted loaders, blades and other attachments fit both gasoline and diesel models of the new Ford tractor line for 1958. Get all the facts on these new Ford Diesel Tractors from your nearby dealer, or write to Tractor and Implement Division, Ford Motor Company, Birmingham, Michigan.

Now! Many Ford tractor models with gasoline, LP-gas and diesel engines

YOU SEE MORE FORDS BECAUSE THEY SAVE MORE MONEY!

HANDLE ALL THESE JOBS AND MANY MORE...AT LESS COST!

To order these helpful booklets check the reply card opposite page 36.

Complete Line of Asphalt Patching Mixers

586. Mixers capable of mixing 3 to 20 tons of hot mix per hour are described in literature available from McConnaughay Mixers, Inc., Lafayette, Ind. Check the reply card for full information on patching, repairing, resurfacing and sealing.

Hydrocrane Used As A Backhoe, Crane or Clamshell

606. When your work calls for lifting, digging and trenching all in the same day you need a machine that converts from crane to clamshell to hoe quickly and easily. Check the reply card or write Bucyrus Erie, South Milwaukee, Wisc. for information on the Hydrocrane.

Use The Reply Card

Crane and Excavator Mounts on a Conventional Truck

621. Sherman 4-ton lift capacity crane and excavator is described in catalog from Sherman Products, Inc., 3200 West 14 Mile Rd., Royal Oak, Mich. Dimensions and operating data, crane lifting capacities and boom charts are included. Check the reply card.

What You Should Know About a Motor Grader

673. Photographs, sketches and other instruction illustrations aid readers to visualize details of the Allis-Chalmers Model Forty-Five motor grader mechanical features and components. The catalog also tells about attachments and accessories. Write Allis-Chalmers Mfg. Co., Tractor Group, Milwaukee, Wisc.

Slide Rule PS1 Calculator For Concrete

713. A new pocket size slide rule calculator for the testing of concrete in compression is available from Forney's Inc., P.O. Box 310, New Castle, Pa. It is designed to convert instantly the pressure applied to concrete cylinders and blocks into psi.

STREET LIGHTING AND TRAFFIC CONTROL

Latest Data on Prestressed Concrete Lighting Standards

265. Comprehensive data on prestressed concrete standards for street and highway lighting is contained in a 24-page catalog which contains complete engineering tables and descriptive information on design features, mounting arrangements, base type choices and specifications of Hy-Lite standards. Get helpful and easy-to-read Catalog No. 300 by writing to American Concrete Corp., 5092 No. Kimberly Ave., Chicago 30, Ill., or check the reply card.

Practical Outdoor Lighting

489. P & K luminaires and standards for outdoor lighting provide good lighting and complement the architecture and design. Check the reply card or write Pfaff & Kendall, 84 Foundry St., Newark 5, N. J., for models and types.

PR System of Coordinated Traffic Signal Control

589. This bulletin describes the PR local controller which carries out the directions of the Electro-Matic Master in the all-electronic equipment for coordinated traffic signal operation. Check the reply card or write Automatic Signal Div., Eastern Industries, Inc., Norwalk, Conn., for this valuable bulletin.

Engineering Guide on Mercury Street Lighting

640. Technical data on mercury lamps applicable to general lighting service, operating characteristics of the mercury vapor lighting system and economic evaluation of lighting systems designed for equal lighting results are several of the sections covered in catalog from Westinghouse Electric Corp., Lighting Div., Edgewater Park, Cleveland, Ohio

RECREATION

How to Equip Your Parks and Playgrounds

414. A handsome 60-page illustrated catalog showing a full line of extra heavy duty playground, pack-picnic and dressing room equipment, plus many related items, is now available from American Playground Device Co., Anderson, Ind. Complete specifications, construction features, prices and details of labor and materials needed for installation are included. Check the reply card.

Rubberized Playground Surfacing Material

668. Saf-Pla can be applied to black top, concrete or properly surfaced areas to reduce injuries from children falling. Check the reply card or write to U. S. Rubber Reclaiming Co., Inc., Box 365, Buffalo 5, N. Y.

WEED AND DUST CONTROL

Investigate "Tifa" For Insect Control

47. With "Tifa", the Todd Insecticidal Fog Applicator, chemicals are distributed as a true, clean fog. Use reply card for full data on public health programs. Products Div., Todd Shipyards Corp., Columbia & Halleck Sts., Brooklyn 31, N. Y., Greens Bayou, Houston 15, Texas.

How to Cut Weed Control Costs

308. Information on a weed killer that can save hundreds of man-hours of clearing and cutting is available from Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio. Whether you want to control weeds or brush or both, without damage to crops or ornamentals, get this literature today by checking the reply card.

TIME FOR DRILLING 3½" HOLES THROUGH 10" REINFORCED MERAMEC GRAVEL CONCRETE FLOOR CUT FROM 6 HOURS TO 30 MINUTES

JOB: Cut 150 holes 3½" diameter through 10" concrete floors for new conduit feeders in the warehouse section of the old Mart Building, now the St. Louis Area Support Center, St. Louis, Mo. The Building, constructed in 1932, was built of concrete containing Meramac gravel aggregate—"the next thing to flint". Chiseling these holes would have resulted in jagged and uneven holes, much dirt and noise, a big clean-up job and much patching to finish up the job and would have averaged six hours each for two men.

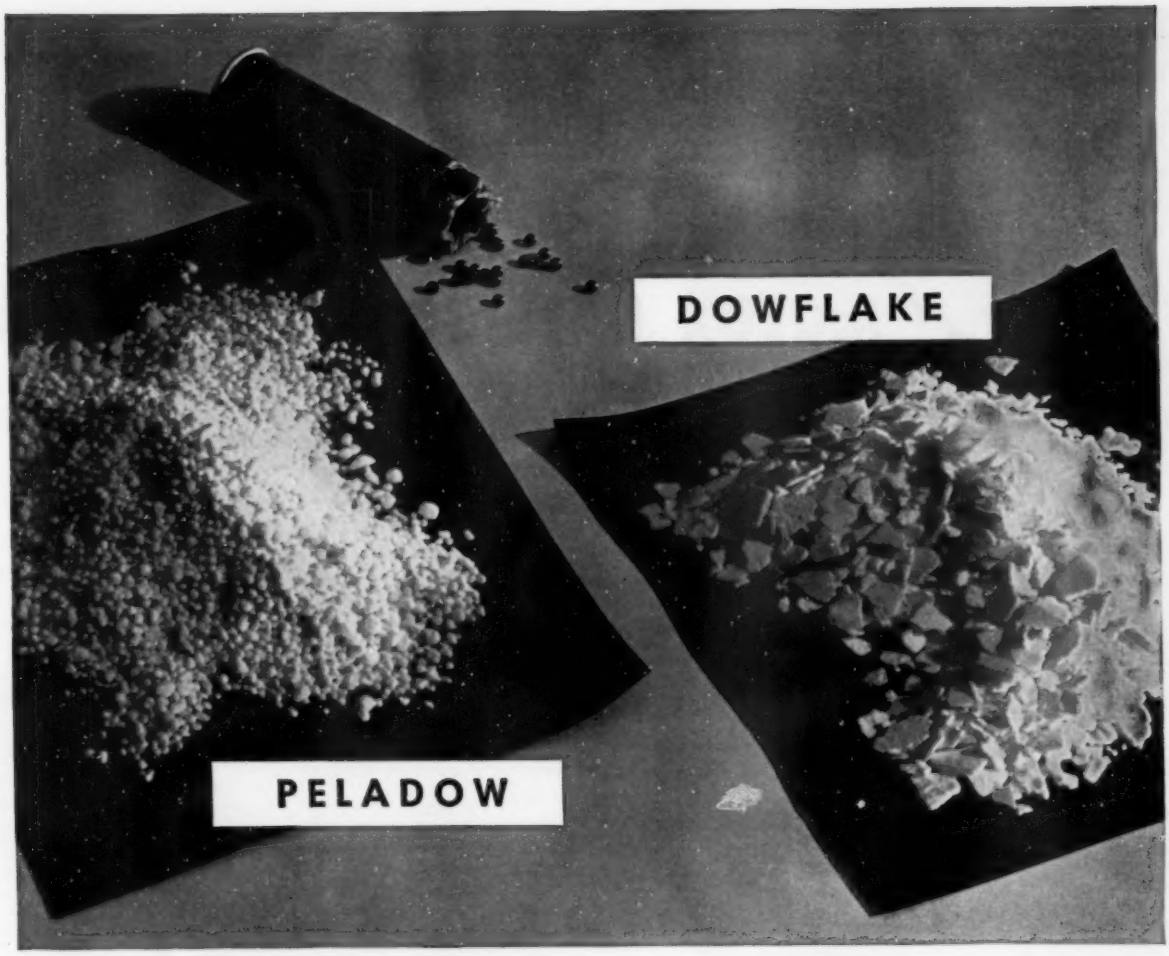
CONTRACTOR: The Sachs Electric Corporation, St. Louis, Mo.

TOOLS: Model C Truco Diamond Drilling Machine with 350 rpm motor and 3½" O.D. Truco Diamond Drill Bit.

DESCRIPTION: Truco unit was used mounted on its mobile base and moved to location on its rubber tired wheels. Actual drilling time on each hole was from 6 to 9 minutes depending upon the number of reinforcing rods to be cut. Each completed hole averaged 30 minutes including all moving, set-up and core removal. (Compare with previous 6 hours for two men with air hammers.) Completed hole was clean and smooth and no patching needed. Truco unit is completely portable by one man and is designed for high speed drilling in practically any location. Wired for 110 V, 60 cycles or less.

WRITE FOR NAME OF NEAREST DISTRIBUTOR

Truco Swivel Division
WHEEL TRUEING TOOL CO.
33-3200 W. Davison Ave. • Detroit 38, Michigan



Which calcium chloride for you?

It is agreed: To improve construction of concrete roads, to maintain unpaved roads, to control ice and dust—nothing beats calcium chloride. But which calcium chloride is best for you? Flake or pellet? What concentration?

In answer, Dow offers two forms. Dowflake® comes as flakes in a 77-80% concentration; Peladow®, a 94-97% concentration, comes as buckshot-sized pellets. Both provide the faster set, increased workability, density and strength so desirable in concrete. Both stabilize unpaved roads, reduce gravel loss as much as 85%. Both control ice and dust with a cleanliness and efficiency unmatched by other materials. And for application and handling ease, both flow freely. The important difference is this: Peladow is especially designed for bulk shipment in tank cars or covered hopper cars and is easily handled in auger type conveyors. In some areas, its high concentration cuts freight and handling costs, because you require 20% less per application. Which for you? Peladow or Dowflake?

The quantity required and how you use it will help you choose. And so will we! For information and proved recommendations, name your use and write THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. CC 503A.

YOU CAN DEPEND ON DOW

The flexible joint... especially designed for river crossings and other difficult installations

American
MOLOX BALL JOINT
Cast Iron Pipe

River crossings and other underwater pipe installations present no problems when you select American Molox Ball Joint pipe. Its rugged construction adapts it to a wide variety of installation methods, and once laid, the joint remains bottle-tight under pressures up to several hundred psi at any angle within the range of liberal deflection it provides.

Designed to meet the severe requirements of submarine pipe lines, American Molox Ball Joint pipe offers all the advantages of high strength Mono-Cast cast iron pipe with the socket cast integrally with the pipe, a heavy alloy cast steel follower gland for added strength, plus the finest bolting of any flexible joint pipe available today . . . using a full set of high strength, large diameter, corrosion-resistant American stainless steel bolts.

Compare the special features of American Molox Ball Joint pipe with other flexible joint piping. Write now for a new 32-page descriptive brochure. See for yourself how American Molox Ball Joint pipe has been installed under various installation conditions.

Visit Booths 117-118
American Water Works Association Conference
Dallas — April 20-25

AMERICAN
CAST IRON PIPE CO.
BIRMINGHAM 2, ALABAMA

SALES OFFICES
New York City • Dallas
Chicago • Kansas City
San Francisco • Denver
Pittsburgh • Los Angeles
Minneapolis • Cleveland
Orlando • Birmingham

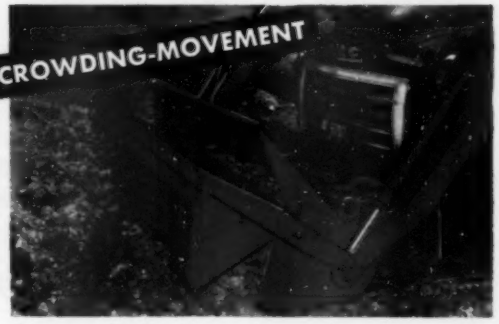
New HOLMES-OWEN TRUCK LOADER

The *Only* LOAD-and-HAUL Unit with *ELBOW-ACTION*

The one factor which gives the HOLMES-OWEN Loader such rugged strength and flexibility of operation is the "Elbow-Action" provided in its lifting arms. Through this exclusive feature, the upward and forward cycle of the bucket can be very accurately controlled, thus permitting a "Crowding-Movement" not possible with other type truck loaders. The ¾ yard bucket is activated by powerful, double hydraulic cylinders. All controls are conveniently located in the truck cab, which enables the driver to handle a wide variety of jobs such as: light digging, grading and loading, without additional manpower or equipment.

There are 3 types of loaders, each adaptable to different kinds of work—the *Standard loader* with a scoop-type bucket is for self-loading and hauling. When equipped with a *Forward-Type bucket*, the unit is capable of loading other trucks, as well as itself. The *Claw-Type bucket* works either forward or backward, but is faster and more efficient since it allows the operators to pick up about 25% more material per bucket. Either type loader can be used with a standard dump truck body and may be installed on most any 2, 2½ or 3 ton truck. Write factory TODAY for details.

Arms flexed in "Elbow-Action". Hydraulic power forces arms forward and upward permitting loading from a standstill without using traction of truck to fill bucket.



Claw-Type bucket showing downward spading action of jaws as bucket engages material in "Crowding-Movement" necessary for loading.

Forward-Tipping bucket permits use in dual capacity—for self-loading as independent working unit or as loader for other trucks.

"Elbow-Action" assures complete inversion and emptying of bucket without spillage or the need for a cab protector.

ERNEST HOLMES COMPANY - CHATTANOOGA 7, TENN.

WASHINGTON STATE HIGHWAY DEPARTMENT
TRAFFIC ENGINEER: Rex G. Still
SIGN ENGINEER: Alan L. Solberg

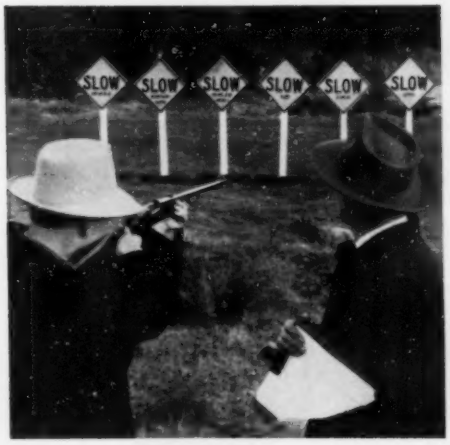
PLYWOOD SIGNS SHOW THE WAY

WASHINGTON STATE highway officials guide motorists with modern color-coded reflectorized signs of overlaid fir plywood. And because they cost less and last longer than metal signs, they mean important savings for taxpayers, too.

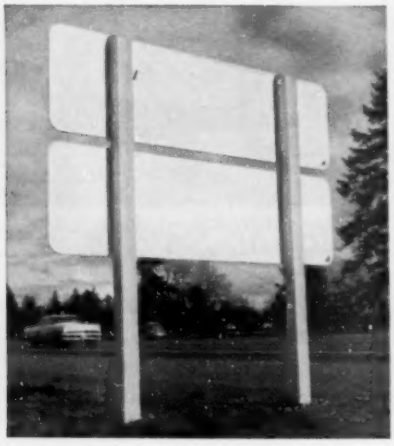
The state has standardized on High Density overlaid plywood for all large directional and informational signs. Reflective sheeting is applied direct, without prime coats. This elimination of painting saves money and the plastic-like high density overlay provides a better and more foolproof bond for the reflective sheeting. Backs are painted only where special colors are required.

For smaller warning and regulatory signs, Washington uses both High and Medium Density overlays. In the case of Medium Density, panels are primed before reflectorizing.

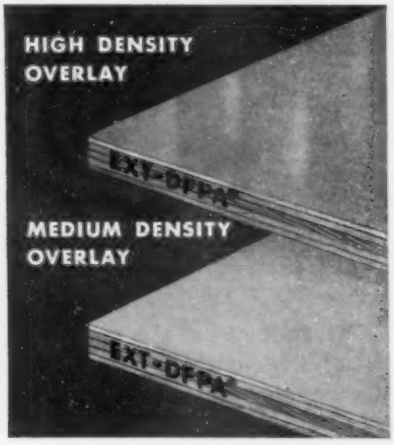
Washington has found that overlaid plywood signs stand up better under severe weathering and accidental or deliberate abuse. There is no rust, corrosion or other progressive deterioration after damage. Plywood signs are stronger and stiffer, too, and require fewer posts and framing members. Panels are light and easy to handle.



Vandalism tests conducted by Douglas Fir Plywood Association show plywood signs far stronger and more durable than steel or aluminum. Bullet holes, for example, are clean, sharply defined, with limited impact area. Write for test report.



Strength and stiffness mean larger size (up to 4' x 8') plywood signs can be installed without backing or framing. On king-size shoulder mounted or overhead signs, supporting framework is greatly simplified. Panels are light, easy to handle.



Durable overlay eliminates checking, grain raise. High Density overlay needs no paint protection; reflective sheeting may be applied direct. Medium Density is for plain painted signs. Base panel is waterproof Exterior (EXT-DFPA®) plywood.

FOR MORE INFORMATION (detailed specifications, application data, etc.) write to:

DOUGLAS FIR PLYWOOD ASSOCIATION
TACOMA 2, WASHINGTON
—a non-profit industry organization devoted to research, promotion and quality control

DFPA TESTED QUALITY

for the ultra-modern service areas of historic Williamsburg...

SOMETHING NEW

in Lighting Standards

HY-LITES IN COLOR

Design 705-Hy-Lite standards, with single and twin six-foot brackets, are used in lighting the recently completed Information Center area of Colonial Williamsburg.

COLOR . . . a new concept in lighting pole manufacture . . . has been introduced in Williamsburg, Virginia, by American Concrete. "Colonial Red" lighting standards with a luminaire mounting height of 27′ 7″ are used in parking areas, while short, upright Hy-Lites help light motel areas.

The blending of Hy-Lite beauty with lighting efficiency makes this an ideal installation for the new Information Center, Motor House and cafeteria areas of Williamsburg. You too will find that American Concrete offers a perfect pole design to meet the most exacting requirements. For attractive appearance and long-life economy, Hy-Lite standards have no equal.

Write for detailed information. Address American Concrete Corporation, 5092 North Kimberly Avenue, Chicago 30, Ill.

Typical upright standard used in new Motor House areas of Colonial Williamsburg.

American Concrete

PRESTRESSED CONCRETE LIGHTING STANDARDS

On an automatic 3' x 4' vacuum applicator, one man can turn out 72 street name signs of "Scotchlite" Reflective Sheeting per hour.

SPECIAL DEMONSTRATION OFFER!

144 reflective street name sign faces, plus hardware...

a $450.00 value...now only $299.00

Installation of *reflective* street name signs is a public service you've probably thought about... but perhaps never started. This special offer, then, *Operation 144*, is made for you. For now, you can start your program with a prepared package designed to give you a low cost, yet extensive, demonstration that will *prove* to all who see it the civic value of *reflectorized* street name signs.

What you get

Right now, you'll receive (at a $151 saving) a complete package for signing 36 intersections:

- 144 6" x 24" street name sign faces of Wide Angle Flat-Top "Scotchlite" Reflective Sheeting (your choice of blue, green, yellow or silver backgrounds).
- 144 strong, durable Aluminum Panels.
- 36 brackets with hardware.

You specify as many as 15 different street names. We screen them for you. And they arrive ready to be applied to the aluminum panels quickly and easily in your own sign shop.

What test shows

Once these dramatic signs are installed, you'll find traffic flows more smoothly because you *eliminate* the danger of a nighttime driver who has to slow down or stop to read ordinary street name signs. And, since these distinctive street name signs of "Scotchlite" Reflective Sheeting inform motorists more effectively both day and night, the program performs a real public service for your entire community.

Offer is limited

Only one *Operation 144* package can be delivered to each community. And the low, special $299 price expires May 1, 1958. Your 3M Representative has full details and he will be happy to help work out your demonstration program. See him soon. Or write for details to: 3M Company, Dept. QV-48, St. Paul 6, Minn.

WIDE ANGLE FLAT-TOP®

REG. U. S. PAT. OFF.

SCOTCHLITE

BRAND

REFLECTIVE SHEETING

3M

The terms "Scotchlite" and "Flat-Top" are registered trademarks of Minnesota Mining & Mfg. Co., St. Paul 6, Minn. General Export: 99 Park Ave., New York 16, N.Y. In Canada: P. O. Box 757, London, Ontario.

MINNESOTA MINING AND MANUFACTURING COMPANY—where RESEARCH is the key to tomorrow

PROOF!

To Whom It May Concern:

You can be sure of making the wisest investment and obtaining the most productive equipment by inviting leading manufacturers to participate in competitive on-the-job demonstrations with qualified operators.

The demonstration reported here was held last year at my request and I personally kept the records of the times and tonnages in all instances.

The results gave me definite proof of the superior performance of the "PAYLOADER" machine and was the basis for my recommendation for the purchase of this equipment.

Phil Bigham

PHIL BIGHAM
County Engineer
Barton County, Kansas

Independent Tests with Factory-Trained Operators Prove PAYLOADER® Best

You can't make money on manufacturers' claims. It's performance on-the-job that counts. That is why we welcome the opportunity to report the results of independent, unbiased competitive tests such as the one tabled below. "PAYLOADER" tractor-shovels will not only give you greater performance and production . . . they'll PROVE it on your job.

	Run No.	Travel Distance	Model HO PAYLOADER	Machine "A"	Machine "B"
Loading Trucks from Stockpile... Tons per Hour	1	——	432	289	222
	2	——	391	324	254
	3	——	366	311	259
	4	——	358	288	285
Loading Trucks from Windrows... Tons per Hour	5	150 ft.	327	192	207
	6	150 ft.	313	192	178
	7	100 ft.	390	262	240
	8	100 ft.	394	274	253
Overall Average...Tons per Hour			**371**	**267**	**237**

Ask about . . .

PURCHASE AND HOUGH LEASE PLANS

Your Hough Distributor offers the widest choice of financing plans: TIME PAYMENT . . . LEASING PLANS*, with or without OPTION TO PURCHASE — whatever one best fits your needs for the purchase of "PAYLOADER" units. See him today.

Modern Materials Handling Equipment

THE FRANK G. HOUGH CO.

LIBERTYVILLE, ILLINOIS

SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

*Available in Continental U. S. A.

THE FRANK G. HOUGH CO.

761 Sunnyside Ave., Libertyville, Ill.

Send more data on 4-wheel-drive "PAYLOADER" tractor-shovels as checked:

- ☐ HO—9,000 lb. carry cap. (1 to 4 cu. yd. buckets)
- ☐ HH—7,000 lb. carry cap. (⅞ to 3¼ cu. yd. buckets)
- ☐ HU—5,000 lb. carry cap. (⅝ to 2½ cu. yd. buckets)

Name.....

Title.....

Company.....

Street.....

City.....State.....

4-B-1

Over 100,000
WARN HUBS
now in use on
4-wheel drives!

Models for all makes 4 w. ds. to 1½ tons at local dealers'.

Jeep

STOP FRONT DRIVE WEAR, DRAG AND WHINE IN 2-WHEEL DRIVE!

SAVE ON EQUIPMENT . . .
SAVE ON REPAIRS, GAS, TIRES . . .

Install either Warn Lock-O-matics, the hubs that "shift for themselves", or get Warn Locking Hubs and "dial the drive" with your fingers. You'll never again have a 4-wheel drive without Warn Hubs!

WARN MFG. CO., Inc. Riverton Box 6064-P4 Seattle 88, Wash.

LOWEST COST SPACE CONTROL
THROUGHOUT THE COMMUNITY

TIFA

Mosquitoes, Flies and Other Insect Pests Destroyed on Contact

On the dump, over pools, in suburbs, play areas, stockyards, TIFA gets the kill every time . . . at the lowest operating and maintenance cost. TIFA rapidly covers large areas with true clean fog, permeates smallest crevices, envelops and destroys all insect pests. This efficiency with newest or older type insecticides, gives you a better insect control program for your community.

TODD INSECTICIDAL FOG APPLICATOR

BEST by TEST for over 13 years in Community Fly and Mosquito Programs

Carrying Underwriters' Listing Seal MH 4162

Write for illustrated folder with details and official comments.

PRODUCTS DIVISION

TODD SHIPYARDS CORPORATION

HEADQUARTERS: Columbia and Halleck Streets, Brooklyn 31, N.Y.

PLANT: Green's Bayou, Houston 15, Texas

AGRICULTURAL SOIL MAPS

This 1957 revision of a previous publication brings up to date the status of agricultural soil mapping in the United States and lists the technical personnel involved in the soil mapping program in the several states. Of primary importance to highway staff personnel is the detailed county-by-county breakdown of the mapping status for each state. With this table it is possible to tell at a glance what is or is not available from the agricultural soil viewpoint. Copies are available from Highway Research Board, 2101 Constitution, Washington, D. C. and are priced at $2 each.

WOOD RESEARCH AND ENGINEERING

The highlights of twenty-five years' service to the designing, building and wood producing and using industries are described in the pictorial anniversary report, "Our Twenty-Fifth Year," which also illustrates the services and facilities of the organization. Copies of the publication are available, without charge, from Timber Engineering Co., 1319-18th St., N.W., Washington, 6, D. C.

SOIL DENSITY CONTROL METHODS

The four papers in this bulletin are significant contributions toward betterment of our knowledge of compaction, of methods of controlling compaction, and methods of measurement of soil density. Copies of Bulletin 159 are $2.80 each, and are available from Highway Research Board, 2101 Constitution, Washington, D.C.

LANDSLIDES AND ENGINEERING PRACTICE

It is the purpose of this book to bring together in coherent form and from a wide range of experience such information as may be useful to any engineer who must recognize, avoid, control, design for or correct the more important types of land-

Made of malleable iron. Single massive bolt. All sizes, 1/2" to 12" inclusive. For steel, cast iron and Transite pipe.

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Orangeburg *Perforated* Pipe keeps cellars dry. Makes efficient, long lasting foundation footing drains.

Unique Snap Coupling maintains alignment, gives permanent joint cover, permits seepage at joint.

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Make sure you get *genuine* Orangeburg. Look for the Brand Name on Pipe and Fittings. For more facts write Dept. PW-48.

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slide movement. The book is divided into two parts. Part 1, called "Definition of the Problem," is intended to provide the engineer with the tools and methods he needs to solve an actual or potential landslide problem. Part II, called "Solution of the Problem," summarizes the methods known to have been applied to the prevention and control of landslides; it also discusses the methods of making stability analyses and of using them in the solution of design problems. This 232-page book is available from Highway Research Board, 2101 Constitution Ave., Washington 25, D. C. at $6 per copy.

BASIC SOILS ENGINEERING

This text has been designed to present primarily the basic material required for dealing with common soils problems in general practice and is intended to serve as a reference work for those who, initially at least, do not intend to specialize in any aspect of the field. Information on fundamental properties of soil has been assembled, not only from engineering sources but from agronomy and the soil sciences, and is presented in engineering terms. Applicable material from the fields of hydraulics and mechanics is included. The application of this information to problems in foundation and highway engineering alike is explained from the practical viewpoint, taking into consideration not only theoretical considerations but conditions and difficulties which arise during construction. The author is B. K. Hough, Professor of Civil Engineering, Cornell University. Publishers are The Ronald Press Co., 15 East 26 St., New York 10, N. Y., and the price is $8.

ESTIMATING GENERAL CONSTRUCTION COSTS

This handbook provides an accurate method of estimating all direct production costs and includes the following sections: Earthwork covering excavation, compaction and earthmoving; reinforced concrete work including form fabrication, form erection, placing reinforcing steel, placing concrete and concrete finishing; structural steel work giving data on erection, riveting, welding and bolting; masonry covering brick, clay tile, glazed tile, concrete blocks, stone veneer, ledgestone, flagstone and terracotta; and rough and finished carpentry. Author is Louis Dallavia and publishers are F. W. Dodge Corp., New York City. Price per copy is $8.50.

Shape is important

IN A LIGHT STANDARD TOO!

Our octagon shaped design was no accident! We thought about *strength* as well as beauty . . . and comparison tests show the octagon shape to be 12.2% stronger than the round and 39% stronger than the fluted shape.

Our new catalogs on steel and aluminum standards tell about this and other features you will like. We'll be glad to send them free. Just drop us a line. Address: Dept. P-4.

Approved by leading architects, engineers, contractors and City, County, State and Federal officials. Installations in over 170 cities and towns.

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Palatable Water is Satisfying Water

In most communities, palatable water is taken for granted — something a resident feels he is entitled to. There are areas, however, where the water has noticeable taste and odor. If your water is in the latter category use AQUA NUCHAR.

AQUA NUCHAR activated carbon removes unwanted tastes and odors from water through adsorption. Regular treatment throughout the year will allow you to deliver to your customers a water that is palatable, sparkling and satisfying.

At your command is an experienced staff of water technicians. At no obligation to you, they will be happy to survey your plant and recommend how and where AQUA NUCHAR can best be used to give you better water.

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You can run a Rockwell Sealed Register Meter

UNDER WATER...

You Can Run This Sealed Register Meter

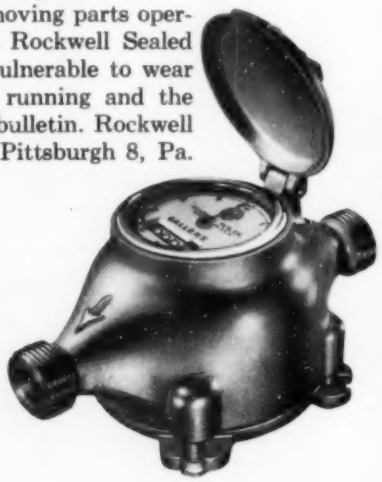
UNDER WATER!

You who have had meters stopped and registers ruined in flooded basements or curb boxes know what it means in trouble and expense. The Rockwell Sealed Register water meter forever ends that problem. Water, muck and grime just can't get into the hermetically sealed register.

Too, you can always read this new Rockwell meter. Condensation, which so frequently mists and obscures the dial face of conventional meters, can't occur with this sealed construction.

In the matter of maintenance, with Rockwell Sealed Register meters you'll never again need to service leaky or bound stuffing boxes—*for there are none!* A powerful magnetic coupling between the measuring chamber and the sealed register positively transmits motion without mechanical linkage or seal.

All this, plus only two moving parts operating in water, make the Rockwell Sealed Register meter the least vulnerable to wear or attack—the smoothest running and the most accurate. Write for bulletin. Rockwell Manufacturing Company, Pittsburgh 8, Pa.



Rockwell Research leads the way

with the Sealed Register Meter

The remarkable all-new Sealed Register meter resulted from the combined talents of over 200 skilled Rockwell engineers and technicians. Their work was conducted in the most modern and advanced facilities in the meter industry.

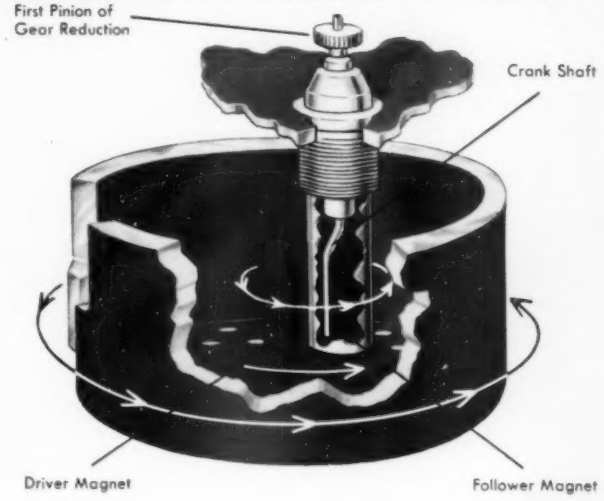
Since the introduction of this meter, one short year ago, water meter history has been re-written. *Your* acceptance of the principles involved and *your* orders from all over the country have demonstrated that a better meter was needed and welcomed.

Just in case you have forgotten, the two important engineering advances which made the Rockwell Sealed Register meter possible are described below.

HERMETICALLY SEALED REGISTER

This sealed register assembly contains all the gearing both for register operation and for intermediate reduction. Gears and pinions are of the free-running instrument type. They offer only token resistance to the measuring element and so improve the accuracy and response of the meter, especially on low flows. This hermetically sealed register construction is located high and dry above the flowing stream. It forever puts an end to condensation problems. There can be no fogging or clouding of the heat treated register glass. With all gearing sealed against corrosion and abrasion, the life expectancy of this unit is almost limitless. It is fully guaranteed for five years.

POWERFUL MAGNETIC DRIVE



In the Rockwell Sealed Register meter a powerful, permanent magnetic coupling is used to transmit motion of the measuring element directly to the register without a mechanical connection. The driver magnet is within the center shaft of the measuring piston. The follower is encased in a watertight housing which extends into the center of the measuring chamber. As the piston oscillates, the driver magnet revolves around the follower. The follower pushes a crank shaped shaft so that the crank transmits every movement of the driver. This crank then drives the first pinion of the gear reduction in the sealed register case.

The Alnico alloy used in this magnetic coupling is a complex alloy, especially developed for this service. Laboratory control assures its consistency for a lifetime of efficient operation.

Readings stay accurate, revenue high because a *magnetic shield* positively eliminates "cheating" the magnetic drive.

SEALED REGISTER METERS

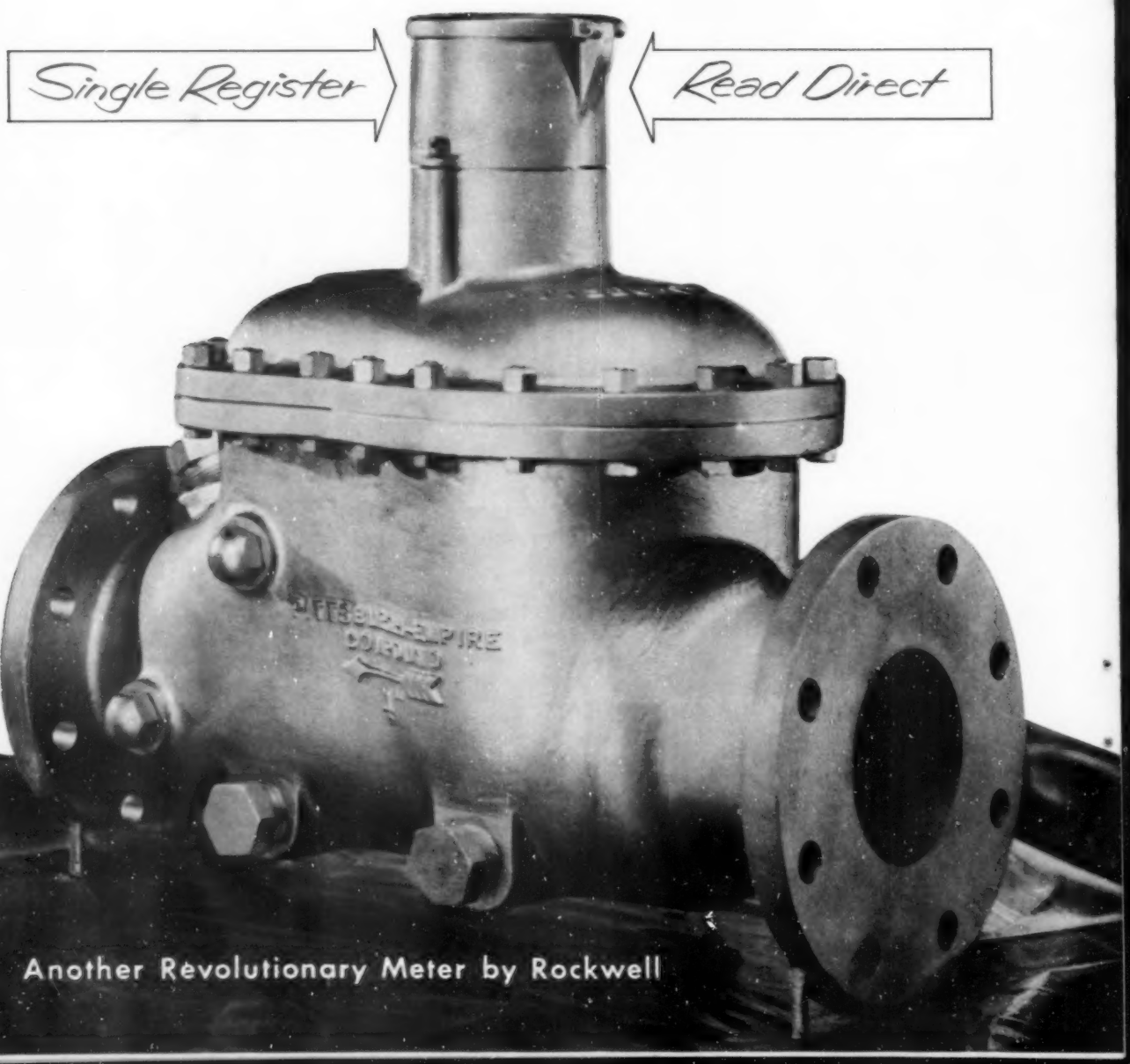
another fine product by

ROCKWELL

Rockwell *Single Register* Compound Meters

FASTER READING . . . FEWER ERRORS . . . NO CALCULATIONS

No other compound meter offers as many *conveniences and advantages* to the operating man. Consider the single register which speeds meter reading and prevents errors. Compare the light weight of these meters . . . the handling ease . . . against conventional compounds. Try and match the full range accuracy, the low pressure absorption, the smooth, quiet operation. And don't overlook maintenance ease. This Rockwell compound can be quickly dismantled or assembled while in the line. Bulletin W-803 gives complete details. Write for it today. Rockwell Manufacturing Company, Pittsburgh 8, Pa.



Cut fuel bills up to 50%

with International® 350 DIESEL POWER

When your jobs call for a tractor to go . . . go . . . go day in and day out, all season long, you can make a big cut in fuel costs with an International 350 Diesel. That's because diesel fuel costs less and you use less of it. Lower fuel consumption is especially noticeable on jobs involving intermittent and part-load operation—such as loader work, and trenching or excavating with a backhoe.

And it's a BIG tractor! 49 engine hp delivers over 5,800 pounds pull at the drawbar, or similar push for dozing. There's up to 1,000 pounds greater built-in weight than usual to tractors of this power class. This greater strength means *stamina* to stay on the job in the most rugged service. Power steering is available optionally to give you top driving ease.

International tractors are available with unit-matched International Pippin and International Wagner loaders and backhoes.

Proof on the job! Ask your IH Dealer to demonstrate. Hold your watch on a measured amount of fuel in the tank, see how an International 350 Diesel can cut your tractor operating costs. For catalog, write International Harvester Company, Dept. PW-4, P. O. Box 7333, Chicago 80, Ill.

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International Harvester Products *pay for themselves in use*—Farm Tractors and Equipment . . . Twine . . . Commercial Wheel Tractors . . . Motor Trucks . . . Construction Equipment—General Office, Chicago 1, Illinois

NEW GREAT

THE HENRY
L-600
UTILITY
LOADER

with new ADVANCED DESIGN

NOW . . . you get more workability at less cost when you buy the new HENRY L-600 . . . the newest and finest loader sold. With lighter boxed-section construction and modern design, it's the best loader buy for the money today.

with new JOB-TAILORING

There's few jobs impossible with a loader that has maximum dumping height, lower operating pressure, equalized weight distribution, and the widest selection of attachments. With the new HENRY L-600 you actually get the job done faster . . . better!

ALSO NEW
THE
HENRY
MARK II
BACKHOE

With 200° arc of swing, 12½ ft. digging depth, maximum operator visibility and control, the new HENRY Mark II is years ahead in design with greater eye appeal. Large diameter pins, chrome piston rods, and replaceable pins at all pivot points make this backhoe outstanding in value.

Get the facts about this new equipment from your nearby HENRY equipment dealer today! Sold and serviced by better equipment dealers everywhere.

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TOPEKA, KANSAS

YOU CAN DO IT BETTER WITH A HENRY

PUBLIC WORKS ENGINEERING DATA

Sewer Trenching in the Horse-and-Buggy Days

A. PRESCOTT FOLWELL
Editor Emeritus

While looking over some old records, I found an inventory of contractor's equipment, with costs, as of 1891 which may be of interest to young engineers. This was equipment used by a contractor in laying sewers in a town in the central part of New York State. The prices were those paid to a local hardware store for shovels and picks; the other items were the estimated values of material previously used by the contractor. Labor was Italian and was paid 85 or 90 cts. for a 10-hr. day; foreman, $1.00 to $1.25.

About 40 men were employed on this job; they were furnished by a "padrone" to whom they paid a commission and also an item for "room and board" in a temporary frame barracks. The "board" was chiefly bread, baked in a home-made brick and cement oven on the premises.

All earth work was by pick and shovel, with one exception. In excavating a deep trench, a cable-operated bucket-carrying traveler, an invention of Moore of Buffalo, was used. (This and the one invented by contractor Carson of Boston about 1885 were, I believe, the only trenching machinery used prior to 1900).

About the middle of this job, and just after receiving payment on his monthly estimate, the contractor absconded without having paid the laborers for the previous two weeks. I had been engineer in charge of the work, and was asked by the town council to continue the construction, using the tools and materials left by the contractor, until other arrangement was made by the bonding company. The sheriff seized the material and turned it over to me making the inventory shown in the table for accounting with the bonding company.

Items	Cost	Items	Cost
94 Shovels	$23.50	2 Plank pullers	1.00
43 Picks	34.40	2 Axes	1.00
17 Pick handles	1.00	1 Hatchet	0.50
1 Dirt rammer	?	7 Pails	0.75
2 Mauls	?	2 Saws	1.50
1 Large hammer	1.00	5 Sheeting jacks	2.00
2 Hoes	0.50	½ Pig of lead	2.00

Water Main Construction Costs, Ames, Ia., 1957

Cost data on laying 20,500 feet of water mains have been furnished us by R. E. Hays, Administrative Assistant, Ames, Iowa. Only 90 ft. of 4-in. were laid; this cost $5.509 per ft. On 8,004 ft. of 6-in., labor costs were 61.4 cents per ft., equipment costs 31.1 cents and material costs $3.06; total cost per foot was $3.987. On 2,387 ft. of 10-in., labor amounted to $1.031, equip-

HERE'S the GREATEST TRAFFIC SIGN VALUE in AMERICA

"EZ-ON"®

SIGN FACES BY GRACE

ATTACHES IN LESS THAN 5 MINUTES!

"EZ-ON" Faces, slip on right over present signs. Your signs are never out of service. Standard regulatory and warning copy—in red and white, yellow and black. They meet every need at ½ the ordinary cost!

2 SIZES—2 SHAPES—REFLECTORIZED

"EZ-ON" Faces are made in 24 and 30 in. sizes, octagon and diamond, of light gauge steel, flanged to easily clamp over old signs. Fully reflectorized, they serve night and day meeting all specifications for durability, brilliance and reflective qualities.

SEND IN A TRIAL ORDER

Yes, 2 signs for only $5.00 . . . a special offer. A trial will convince that "EZ-ON" Faces are the answer to traffic sign costs and maintenance.

2 SIGNS FOR

$5.00

SPECIAL OFFER

TRY THEM AND SEE FOR YOURSELF

GRACE SIGN & MFG. CO.
3601 S. 2nd ST.
ST. LOUIS 18, MO.
Dept. WP

Good Roads MACHINERY SCAVENGER

with Catch Basin Attachment

cleans catch basins in minutes

• Proved successful for removal of litter, leaves and other debris from streets, highways, parks, etc., the Good Roads Scavenger, with catch basin attachment, cleans even the deepest catch basin in a fraction of normal cleaning time. Its powerful 6-cylinder engine sucks wet or dry refuse—paper, twigs, leaves, stones, bottles, cans, etc.—through its large 12" intake tube into the large capacity hopper. Deep-reaching snout cleans catch basins in minutes—a job that normally takes two men many hours. The Scavenger is available truck or trailer mounted.

For detailed information on the Scavenger write to the Good Roads Machinery Corporation, Minerva, Ohio.

Good Roads MACHINERY

Scavenger • Leaf Collectors • Leaf Loaders • Mulch-Vac Sweepers • Asphalt and Aggregate Spreaders
Snow Plows • Ice and Sleet Control Spreaders

for lasting quality construction castings

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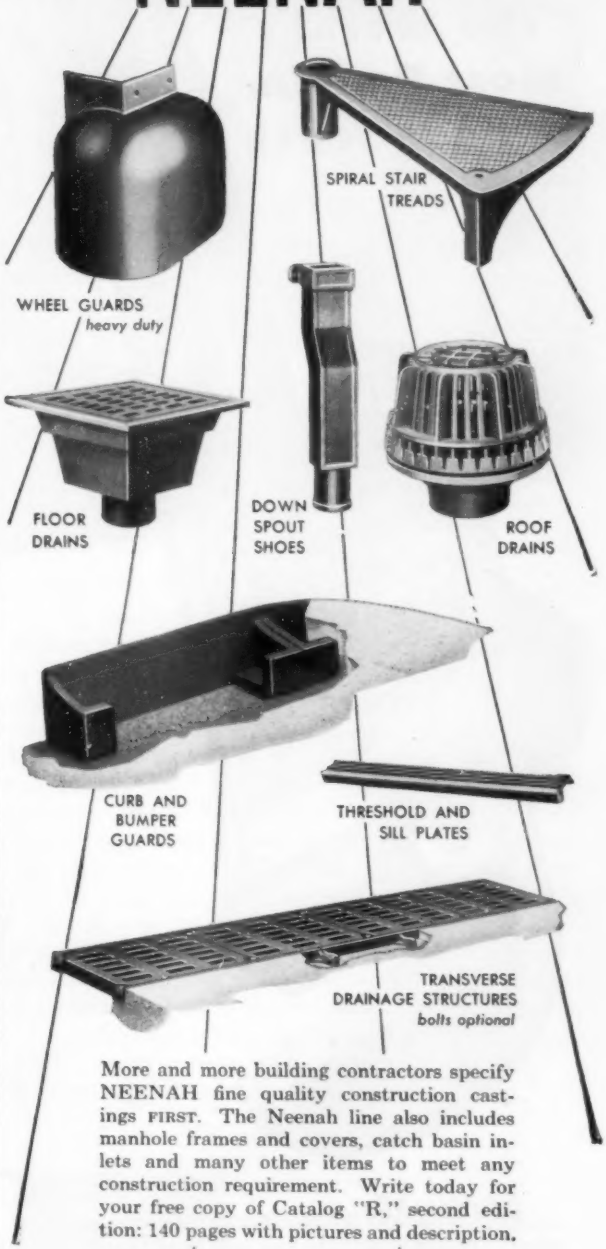

More and more building contractors specify NEENAH fine quality construction castings FIRST. The Neenah line also includes manhole frames and covers, catch basin inlets and many other items to meet any construction requirement. Write today for your free copy of Catalog "R," second edition: 140 pages with pictures and description.

NEENAH FOUNDRY COMPANY

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Chicago Office 5445 N. Neva Ave., Chicago 31, Ill.

...*because* it was a better pipe wrench when first created 35 years ago, and nearly every year since it has been improved . . . in performance, design, materials, so it is still the most for your money. Buy RIDGID at your Supply House.

The Ridge Tool Company, Elyria, Ohio, U.S.A.

ment to 58 cents and materials to $5.134, with total cost $6.747 per foot. On 267 ft. of 12-in., labor was $4.819, equipment 81.5 cents and materials $7.566, a total of $13.201 per ft. On 3,977 ft. of 14-in., labor averaged $1.216, equipment 71.2 cents and materials $7.385, with a total of $9.314 per ft. On 5,775 ft. of 16-in., labor was $1.146, equipment 34.3 cents and materials $8.585, totalling $10.075 per ft.

Costs include all fittings and hydrants, and are complete. Pipe was US mechanical joint, except for the 4-in. Average force was one foreman, an assistant foreman, a pipe layer, a dragline operator, two laborers and one loader operator for backfilling only. Equipment used consisted of a Michigan mobile crane; a ¾-ton boom truck; a Hough Payloader; an Ottawa hydra-hammer; a foreman's pick-up truck; and trucks necessary to remove the excess dirt.

Equipment Rental Fund Operation

An equipment rental fund for the repair, maintenance, operation and replacement of motor vehicle equipment has been established by Tacoma, Wash. The fund which will be administered by the Department of Public Works is subdivided into two accounts for such operating expenses as salaries, materials and overhead; and for equipment purchase and replacement under depreciation schedules. Charges for passenger cars range from $1 per hour or 9 cents a mile for short-term use to a minimum of $88 per month for long-term use.

Ohio's Short Course On Roadside Development

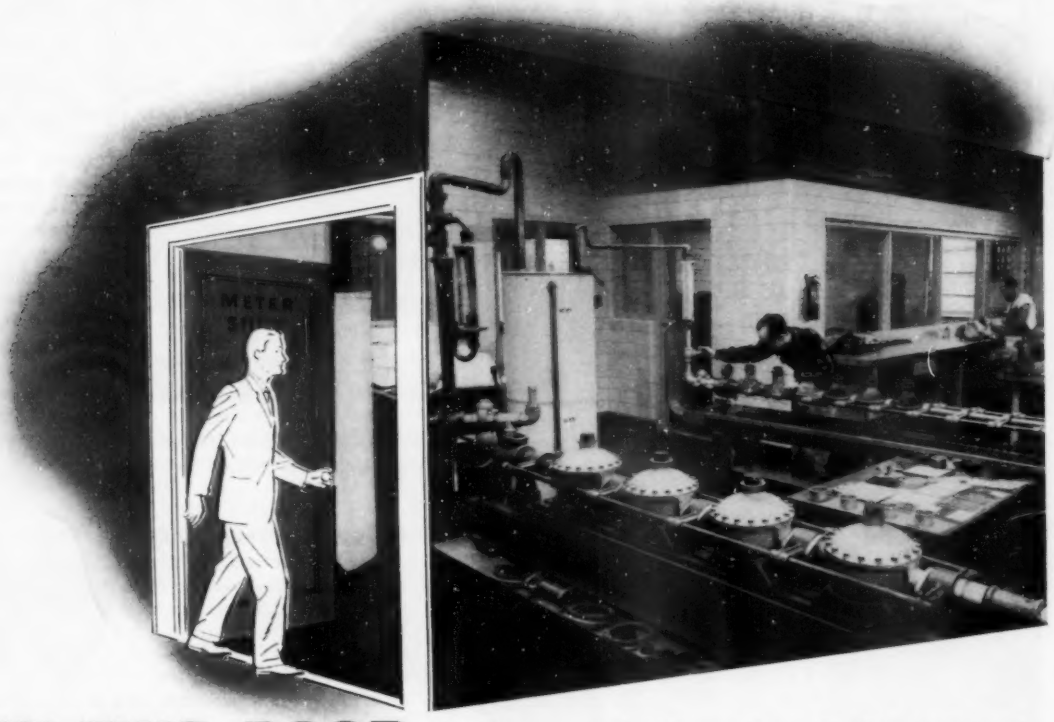
WILBUR J. GARMHAUSEN,
Chief Landscape Architect,
Ohio Department of Highways

OHIO'S Short Course on Roadside Development was initiated by Professor Charles R. Sutton, head of the Department of Landscape Architecture of the Ohio State University, and Dallas D. Dupre, Jr., at that time Chief Landscape Architect of the Ohio Department of Highways.

In deciding the type of Short Course to promote, a study of the Short Courses which were being conducted was made, and the conclusion was that those which were purely educational, with no smokers in direct connection, and no commercial advertising other than equipment displays, were the most successful. Thus it was that the first Short Course on Roadside Development was held in 1941 at the Ohio State University.

Through the years the Short Course has been planned as a part of the educational program of The Ohio State University. It is sponsored by the Department of Landscape Architecture and the Ohio Department of Highways. The program is set up to interest highway engineers, park executives, landscape architects, as well as the lay public. The designated "Short Course" is in line with University policy covering similar concentrated conferences.

The purpose of the first Short Course was outlined as follows: 1) To bring together the specialists working on problems of highway design and the citizens interested in seeing these solved; 2) to interest the public in the value of good highway design; 3) to reduce road costs, particularly maintenance costs, by incorporating sound roadside practices in road construction and design; 4) to strive to keep abreast of the times as the public uses the roads. In other words, our planning must include



OPEN THIS DOOR before you open the bids

You learn more about true meter costs when you open the meters for repairs than when you open the bids.

A water meter is a fine instrument, and any fine instrument loses accuracy as it wears. Because of this fact, written between the lines of any water meter price are two items of cost you can't read for many years.

First, as a meter loses accuracy, it gives away revenue. Before its first overhaul it may give away twice as much money as it "seems" to save in its low-bid original price.

Secondly, to keep the meter accurate you may have higher repair costs over the years . . . or premature scrap-and-repair programs. Good meters often vary widely in this respect.

Water is your city's most vital service. You entrust it to the accuracy of your meters. Before you buy, walk into your meter shop. Talk to the men whose efforts guard your water supply. Ask which meter gives highest sustained revenue . . . with lowest repair and depreciation costs.

We sincerely believe the answer will be "Trident."

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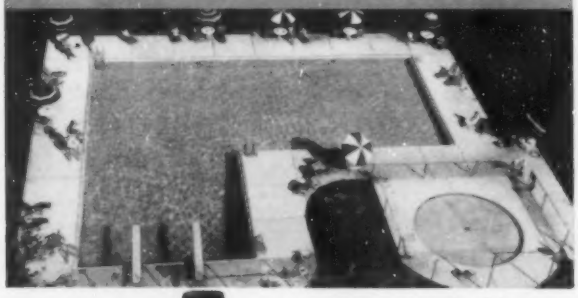
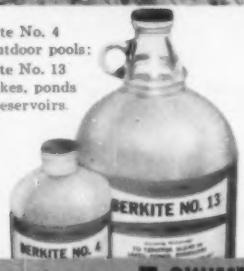
ELIMINATE ALGAE THE modern WAY IN LAKES, PONDS, RESERVOIRS & POOLS

Harmless to fish . . . effective from four to eight weeks . . . Berkite destroys microscopic algae spores in approximately ten seconds! Equally efficient where algae is already visible on surface!

In lakes, ponds, reservoirs, one gallon of Berkite No. 13 to every million gallons of water will eliminate the thickest algae growths with no harmful effects on humans, fish, birds, or wildlife. For outdoor pools, one quart of Berkite No. 4 to 50,000 gallons of water does a maximum job and is completely tasteless, odorless! Actually costs less, too. Both Berkite products are guaranteed by Modern—for over two decades the leading name in pool supplies and equipment.





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FREE CATALOG! Send for your free copy of Modern's new 52-page catalog and Data Book. Includes prices, descriptions, photos, facts on pool care. Call your nearest Modern distributor or write for his name and catalog No. 13Q.

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not only good and safe roads for business, but in addition it must offer an element of comfort and rest. These four principles still continue to guide each of the succeeding Short Courses.

The attendance of the first Short Course was assurance enough that the interest was there. The second year a short field trip was added. As these became more popular, the larger overnight bus trip was started in 1948. The field trip is planned as a demonstration of roadside development practices in Ohio. Stops are made at roadside parks, old and new roadside development projects and other interesting features enroute. Flood control projects, state parks and business enterprises which would be of interest to the group have been inspected.

In 1957, 34 states, with 4 Provinces of Canada and Puerto Rico were represented. Numbers in themselves are not important, yet a good attendance leads toward enthusiastic and animated participation.

For those who attend the conference, proceedings of the meeting are printed to serve as reference material. For those who find it impossible to be present, a pamphlet is prepared as textbook material so that the best current information on roadside development is available. Copies are mailed free of charge to all who request them.

Sewage Treatment Statistics at Cranston, R. I.

The sewage treatment plant for Cranston, R. I., is of the activated sludge type built in 1942 and designed for a 5.5 mgd average flow. Walter C. Anderson is Superintendent and his annual report for 1957 contains some interesting data. Flow was less than normal in 1957, averaging 3.67 mgd, or 87 gpcd; industrial wastes were estimated at 12 percent. Average BOD reduction was 90 percent—from 261 to 25 mgL.

Grit removed averaged 2.17 cu. ft. per million gallons; grease removed amounted to 110 gallons per mg of sewage. With a detention period of 2 hours, the primary settling tanks averaged 8,085 gallons of sludge and 32 gallons of skimmings per million gallons of sewage. The average aeration time was 5.44 hours. Final settling tanks provided 2.02 hrs. detention. Sodium hypochlorite was applied at the rate of 3.7 mgL, producing an average residual of 0.63 mgL. Gas produced by sludge digestion was 1.29 cu. ft. per person per day. Digested sludge was elutriated and dewatered on vacuum filters, using 7.52 percent ferric chloride, and filtering at the rate of 3.24 pounds per sq. ft. per hour.

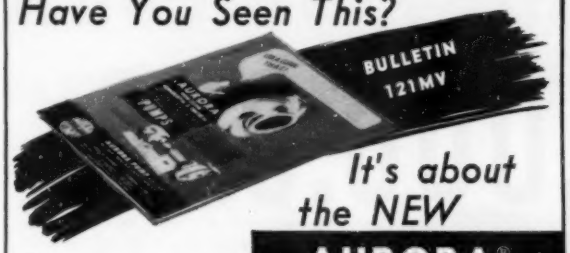
Gel Contains Radioactive Wastes

The use of an aluminum silicate gel to contain radioactive wastes, a discovery of the General Electric Company chemists at the Hanford Atomic Works, has been reported as showing promise in helping solve the difficult radioactive waste disposal problem. Since heavy vaults are now used for burying wastes composed of high-level reactors, a considerable saving in expense is anticipated. Furthermore a source of the aluminum used is the liquid wastes of one of the Hanford plant processes.

Sewer Maintenance Costs

The cost of maintaining the sewer lines serving Arlington Co., Va., for the 1957 fiscal year was $414.66 per mile of line. There are 382.66 miles of sewers in the system. Three crews are assigned to routine maintenance; another crew relieves stoppages, adjusts manholes, repairs damaged pipe, etc.

Have You Seen This?



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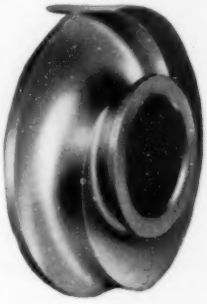
AURORA®
NON-CLOG
HORIZONTAL & VERTICAL
MONO-VANE
SINGLE PASSAGE IMPELLER
PUMPS

The response to our new MONO-VANE Non-Clog Pumps was instant and gratifying. We thought you, too, would find interest in this STEP FORWARD in non-clog pumping technique.



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NO SEPARATE COUNTER-BALANCE is REQUIRED

Other head and capacity requirements may be obtained by the mere trimming of the impeller. The impeller is ALWAYS in DYNAMIC and HYDRAULIC BALANCE — a major advance in non-clog pumping.

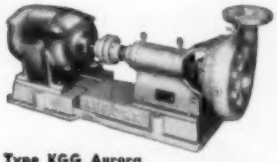
AREAS of APPLICATION

Handles Long Stringy Solids Better than Conventional Non-Clog Impellers • Suited for Industrial By-Products • Semi-Solids • Wastes • Municipal Sewage Plants • Lift Stations • Buildings.

VERTICAL—MONO-VANE PUMPS—HORIZONTAL

These advanced pumps with the exclusive Aurora Mono-Vane Impeller are available in both horizontal and vertical types with 3″ to 5″ (Suction-discharge diam.). Operation is smooth and quiet. Discharge may be turned to various positions. Castings are provided with cleanout opening. Detachable suction and packing covers provide ready access.

Type KU Aurora Vertical Mono-Vane Non-Clog Pump



Type KGG Aurora Horizontal Mono-Vane Non-Clog Pump

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Your Inquiries Will Receive Prompt Attention

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in Swimming Pools it costs no more for the very best Protection!

Josam SWIMMING POOL EQUIPMENT for WATER LEVEL DECK POOLS

The Water Level Deck Type Pool is a more sanitary, safer and more usable pool for all age groups, in addition to being a more economical pool.

The deck level construction permits filling the pool to a level where the bather can roll out of the water to the promenade deck, at any point, in the easy "turtle type" method, without depending on ladders, steps, ramps or other means. This method makes the Water Level Deck Type Pool very advantageous for the instruction of children, paraplegics and other handicapped bathers.

Scum is washed over the coping and out of the pool to accessible drains. The water level which is 1″ below the top of the coping, eliminates hard-to-drain scum gutters above the water line and also effects a saving of cost for formed tile gutters and from 5″ to 10″ of excavation and concrete walls.

Send coupon below for Manual SP-6, the "authority" on swimming pool circulation and drainage. In it you will find typical plans and layouts of pools, with complete descriptions of supply fittings, gutter drains, overflows, outlets, vacuum connections, hair and sediment interceptors and other necessary fittings to meet every pool requirement.

Series No. 0291-B Deck Trench grate

Series No. 0297-B Skimmer grill and access gate

Series No. 0298 Skimmer Fittings with flow control

Series No. 0730-B Balanceze Supply Fitting

Series No. 0380 Main outlet drain

Series No. 0770-B Vacuum Fitting

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General Offices and Manufacturing Division
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JOSAM MANUFACTURING COMPANY
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gallons every day

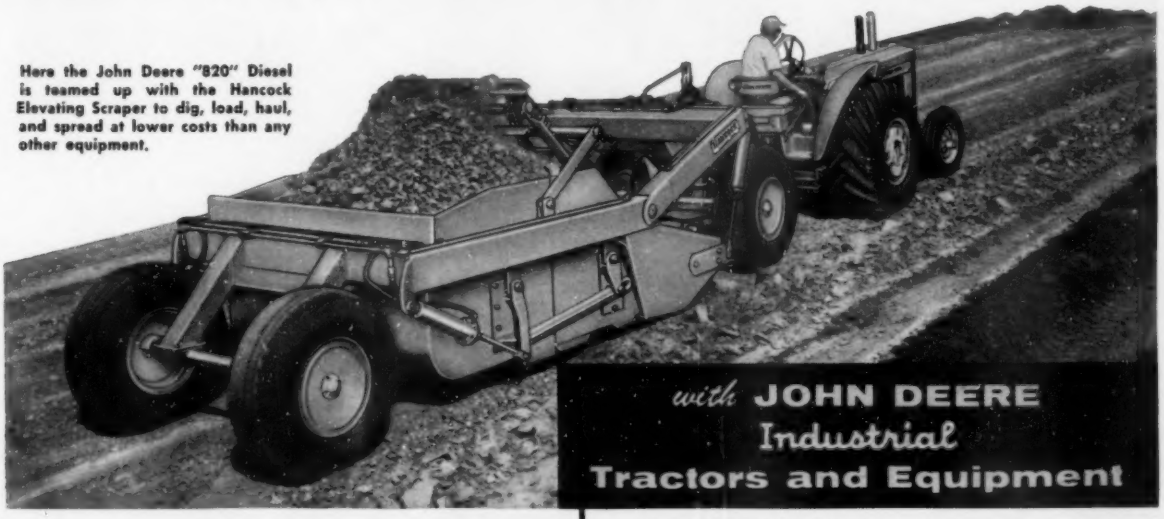
flow through Roberts-equipped plants throughout the Americas

Municipalities and industry alike, throughout the Western Hemisphere, have long recognized the complete assurance of trouble-free service year after year that is built into every Roberts water purification installation . . . the result of over 60 years of specialization and progress.

nameplate of dependability . . .

MECHANICAL EQUIPMENT
BY
ROBERTS FILTER MFG. CO.
DARBY, PENNA.

Keep Schedules Up to Date and Costs Down to Earth...



Here the John Deere "820" Diesel is teamed up with the Hancock Elevating Scraper to dig, load, haul, and spread at lower costs than any other equipment.

with JOHN DEERE Industrial Tractors and Equipment

NOWADAYS public administrators and their contractors avoid expensive schedule bogdowns by using John Deere Tractors and matching equipment to carry the load on public works projects of all types.

Men close to jobs involving clearing, excavating, trenching, grading, paving, earth moving—and many other construction and maintenance operations—know that John Deere Tractors deliver needed power at lower cost. They know that these tractors have a greater "stay-ability" than power units calling for much more in the way of initial price and upkeep costs. What's more, these men know that there are John Deere "bonuses" in the easy operation, easy servicing, and versatility.

Your John Deere Industrial Dealer will be glad to show you the complete line of John Deere Tractors—wheel and crawler—and matched equipment.

New "440" Wheel and Crawler Tractors

The new John Deere "440" is a husky, rugged tractor, designed from grille to drawbar for long, dependable service.

The "420" Crawler and Wheel Tractors

Long famous for doing so much for so little cost, the "420" is shown here bossing a trenching operation.

There's a Model to Match Your Needs

Available in just the model to suit your needs, John Deere Industrial Tractors boast many optional features such as power steering on wheel models and new clutch-type direction reverser on "420" and "440" Wheel and Crawler Tractors.

JOHN DEERE Industrial Tractors and Equipment

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Please send literature on: ☐ "820" Diesel, ☐ "440" Crawler, ☐ "440" Wheel, ☐ "420" Crawler, ☐ "420" Wheel.

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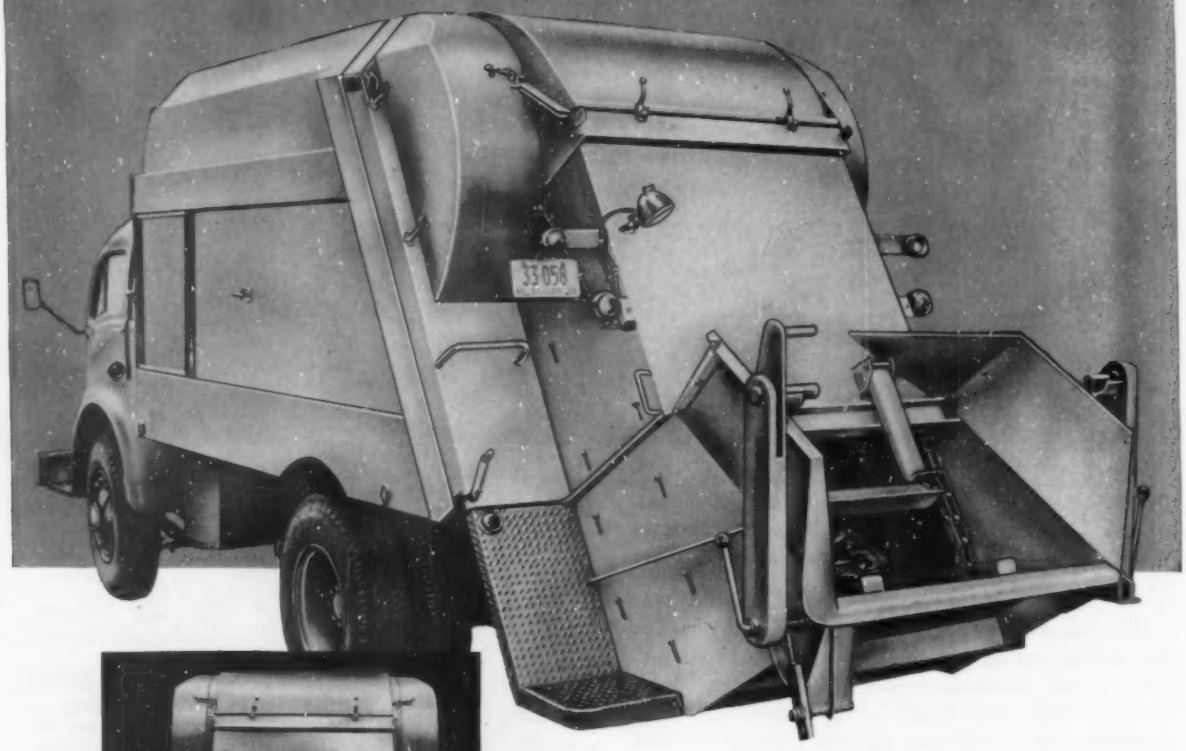
NEW! WIDE HOPPER ROTO-PAC

means *fastest* refuse collection ever



THE ONLY REFUSE COLLECTION UNIT WITH AUTOMATIC CONTINUOUS COMPACTION

TWO MEN LOAD AT THE SAME TIME

Here it is . . . another big advantage with ROTOPAC. Now, ROTOPAC's new 56½" wide hopper speeds loading, permits two men to load at the same time. Thus, with faster loading and no time wasted for compaction, ROTOPAC picks up more than three loads in less time than it takes ordinary, batch-type units to pick up two loads. Imagine how ROTOPAC, with this unequalled efficiency, can cut the cost of your community's refuse collection—picking up more refuse faster with far less units.

For all the facts on ROTOPAC—its non-selective loading, its proven record of minimum maintenance, and its greater preference among loaders—write for helpful brochure.

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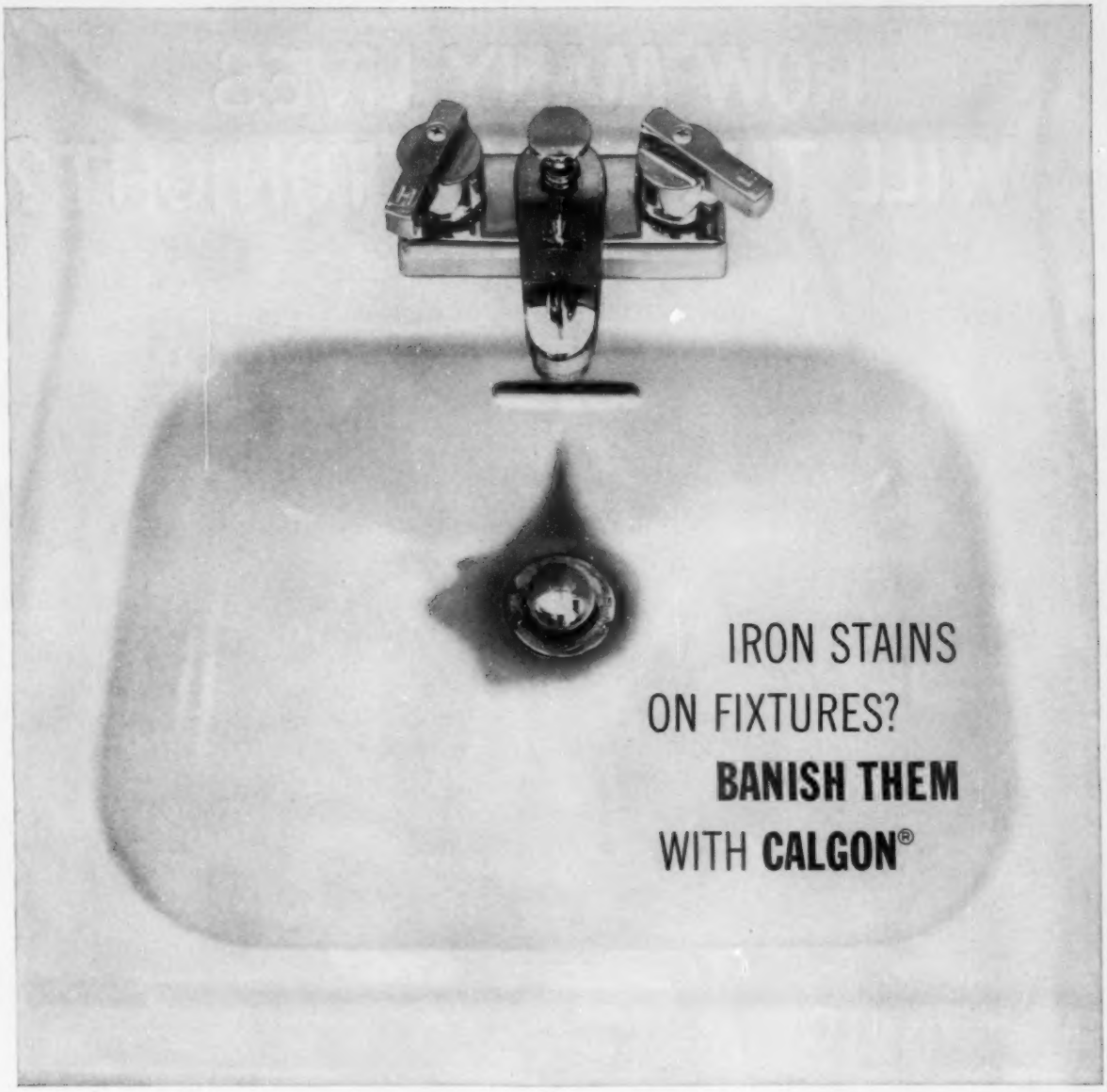

Housewives despair when red water stains mar plumbing fixtures and leave streaks and spots on sheets and linens. And they are loud in their complaints to city officials.

You can turn these complaints into compliments if you adopt Threshold Treatment with Calgon. Calgon stops dissolved iron and manganese from discoloring the water or staining fixtures and fabrics.

Calgon's sequestering and dispersing action stops this precipitation of dissolved iron and manganese—often present in well waters. Red Water is banished, pipe line capacity is retained and the iron or manganese remains *in* the water.

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Non-Reflectorized Pavement Markings . . .

HOW MANY LIVES WILL THEY COST TONIGHT?

The cost of reflectorizing pavement markings is extremely low . . . when you consider the lives that may be lost without it.

It is our firm belief that any stripe worth laying is worth reflectorizing. A great many traffic engineers hold this same view . . . and use Cataphote Reflective Traffic Beads to accomplish this purpose. Their records of reduced nighttime traffic fatalities . . . their records of longer marking life . . . prove it has been a wise investment.

If you'd like more information on Cataphote Reflective Traffic Beads . . . what you can do with them . . . what they can do for you . . . write today.

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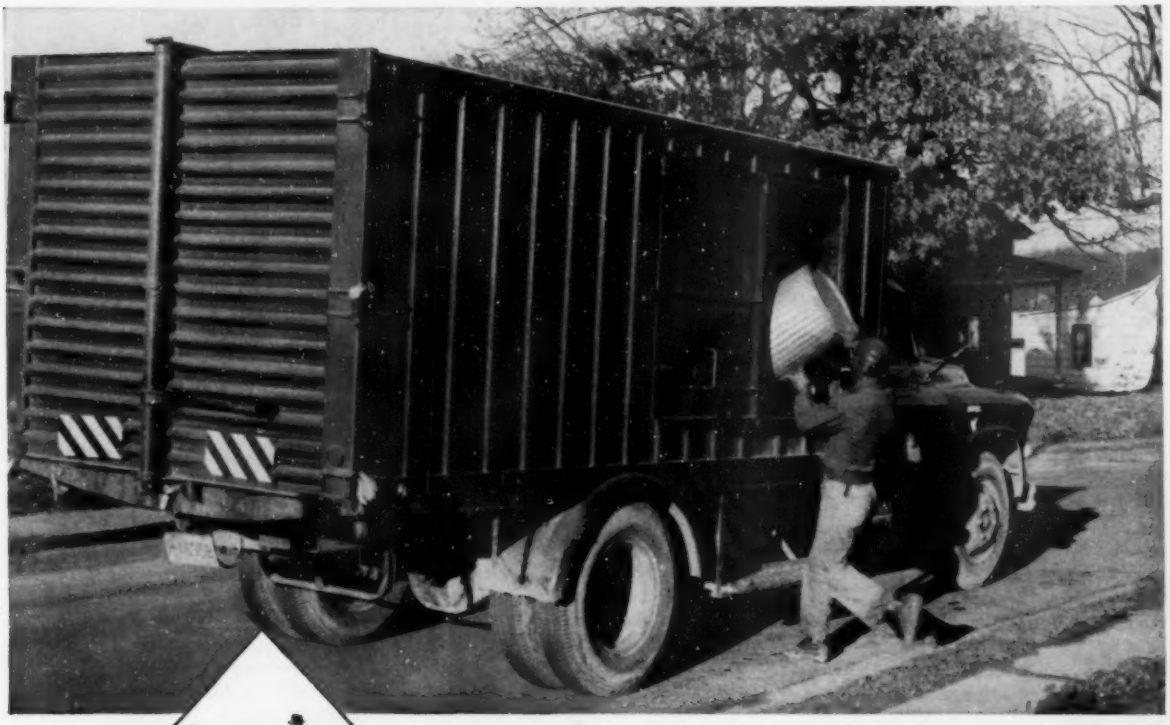
M-B packer improves service ...cuts route time

When the hustling City of Thomasville, North Carolina put a versatile M-B Packer Body to work for the collection of residential and commercial refuse, there was an immediate improvement in service with daily route time cut to only three hours. "Best of all," says Mr. J. F. Mitchell, Superintendent of Streets and Sanitation, "Our M-B Packer saves us $50 a week over the previous method of refuse collection. It is easier and faster to load and will haul any size object. Because of the M-B Packer's design, we get a full-capacity load on a smaller truck than is necessary for other types of bodies." ▪ Yes, easy does it with an M-B



Packer Body. Here's the only modern, sanitary refuse and garbage packer available that has *proved* in actual service to be the unit that provides more benefits from every dollar invested. It's *lowest in original cost*, outstandingly *lower in maintenance cost* and may be mounted on small, *lower cost trucks*. ▪ Together with unbeatable economy like this, you get a powerful packer that handles any type of load . . . garbage, refuse and trash. You get fast loading; powerful, progressive compaction; and safe, quick, "push-out" rear end unloading without raising the body . . . plus many other exclusive features. ▪ Investigate the M-B Packer *now* . . . compare advantages, compare payload capacities, compare economy . . . then ask your distributor for an on-the-route demonstration for final proof. Call him today!

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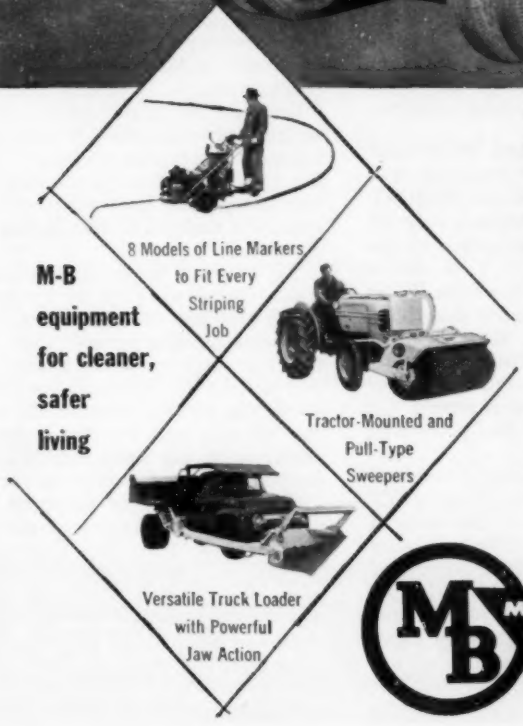
M-B equipment for cleaner, safer living
8 Models of Line Markers to Fit Every Striping Job
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Today's Modern Water Tanks Prestressed Concrete Type

Long and Short Term Economies Making Them Popular

A modern prestressed concrete tank is not only economical in first cost, but because of its almost maintenance free character, offers any municipality real long term economy. Any tankage engineering study should include calculated maintenance costs over the estimated life of the facility. Average yearly maintenance on a 3,000,000 gallon steel tank is estimated at $2500 per year at current prices. For a prestressed concrete tank, maintenance is negligible; however, occasional painting for color effect may be desired.

When the charges for servicing the initial cost plus relative maintenance allowances are plotted, the prestressed concrete tank will often show a lower out of pocket cost to the owner in less than 5 years. When these costs and

their increases are extended for an expected service life of 50 years, the savings to the owner with prestressed concrete are enormous.

The prestressed concrete tank is also a good looking tank . . . it is inherently strong and extremely stable . . . it is designed and built for permanence. And, 75% of the contract price is spent right in your local community . . . construction is done with materials and labor available locally.

Write today for more information on Preload Prestressed Concrete Tanks.

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PRELOAD CONCRETE STRUCTURES, INC.
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LEGAL ASPECTS OF PUBLIC WORKS

MELVIN NORD, Dr. Eng. Sci., LL.B.

Fore!

Townsley v. State of New York, 164 N. Y. Supp. (2d) 840, a New York case decided July 9, 1957, was an action by a motorist for personal injuries sustained when she was struck on the left wrist by a golf ball as she signaled for a turn while driving her automobile on a state highway which ran parallel to the eighteenth fairway of a golf course owned and maintained by the state.

The Court held that where the State had notice of golf balls landing on or across the highway (which was certainly the case here, since it was a State operated golf course), its failure to make known, or erect protective devices to lessen, dangers to persons lawfully using the highway, created a hazard of which the State, in the exercise of reasonable diligence, should have been aware. The State was therefore held liable on the theory of maintaining a public nuisance for injuries which resulted from the hazardous condition.

Water Pollution and Waterford

Application of the Town of Waterford, 164 N. Y. Supp. (2d) 914, a New York case decided July 23, 1957, involved an application by the Town of Waterford, N. Y. to review the determination of the State Water Pollution Control Board classifying certain waters of the Mohawk River as class "C" (i.e. "Fishing and any other usages except for bathing or as a source of water supply for drinking, culinary or food processing purposes.")

It was undisputed that a result of the assignment of classification "C" to the waters on which the Town of Waterford borders will be to require the municipality to construct sewage treatment facilities. The principal ground for complaint by the Town was that this would cause an enormous burden on them, involving a 150% increase in their taxes, requiring them to borrow money up to their legal debt limit, and precluding for a generation all other public improvements of any kind in the Town including streets, schools, fire department equipment, highway improvement, water works extension, and any other form of capital expenditure. Since there was no claim that a public nuisance was present, nor that any question of public health was involved, it was claimed that this would contravene the public interest.

The Court's answer was, in essence—"Tell it to the Legislature, which passed the statute in question."

Construction of Sewers and of State Constitutions

City of Oklahoma City v. Daly, 316 Pac (2d) 129, an Oklahoma case decided Sept. 24, 1957 involved an interesting problem in the "construction" or interpretation of state constitutions.

During the construction of a sanitary sewer, by the City, damage occurred to a private person's building due to vibrations of pile-driving machinery and excavation operations. No negligence was shown or claimed.

The owner of the building brought a suit against the City for compensation for the damages. The City defended on the ground that the two-year statute of limitations on tort actions for damages had expired. The owner, however, claimed that his suit was brought under a provision of the state constitution, providing that "Private property shall not be taken or damaged for public use without just compensation," and that the applicable statute of limitations was three years (which was the period for any liability created by statute). Since the action had been brought more than two years and less than three years after the damage, it was crucial to determine whether

ROAD STABILIZATION CAN BE EASY AND ECONOMICAL, TOO

Only 6 Steps in New Sterling Salt Plan

You can repair and stabilize your gravel roads in just six quick steps if you follow the new Sterling Salt "E-Z Plan" for road stabilization. At the same time, you can minimize the recurring troubles of frost heaving, potholes, dust and costly loss of aggregate. Here's the Sterling Salt program:

1. Scarify surface uniformly to minimum depth of three inches.
2. Test materials for compactability.*
3. Spread Sterling Rock Salt on surface. Use 18 to 30 tons per mile of 20-foot road.**
4. Dry-mix materials with blade. Spread uniformly over road surface, preserving an "A"-type crown.
5. Use water if it is available.
6. Roll if possible, or allow materials to be compacted by traffic.

Initial costs of this program are low. And, equally important, roads stabilized with Sterling Rock Salt cost less to maintain! The six-step program can be accomplished with locally available equipment . . . which further reduces costs of stabilization.

*Simple fist test is all that's necessary. Moisten handful of road material and squeeze it. Mass should retain shape when you release fingers. If not, there is too little binder in soil. Stabilization is not advised until proportion of binder is increased.

**Sterling Rock Salt may be applied before or after scarifying. Depth of stabilized materials should not be less than 3 inches.

FREE . . . SALT-STABILIZATION CASE HISTORIES. This folder contains editorial reprints describing techniques and results. Can be helpful to you in planning stabilization for your roads. Just fill in coupon below.

INTERNATIONAL SALT CO., INC., SCRANTON, PA.

SALES OFFICES: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Richmond, Va.

To: International Salt Company, Inc., Scranton 2, Penna.
Department S1

*Name*_____

*Title*_____

*City*_____ *State*_____

☐ Send free folder.
☐ Would like further technical information from International Sales Engineer.
☐ Would like quotation on price of Sterling Rock Salt delivered to my area.

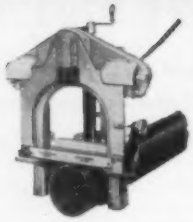
Service and research are the extras in

STERLING SALT

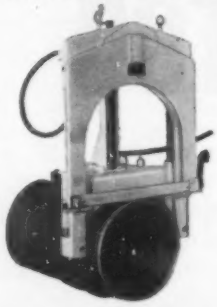
PRODUCT OF INTERNATIONAL SALT COMPANY, INC.

WACHS

PORTABLE POWER AND MANUAL PIPE CUTTERS
2" TO 72" CAPACITY

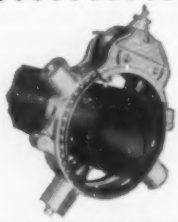


WACHS GUILLOTINE SAW
2" to 8" Capacity
Electric or Air Drive



"BIG" GUILLOTINE SAW
10" to 16" Capacity

WACHS NATIONAL SAW
"The milling machine on wheels"
Cuts 10" to 72" Pipe



WACHS STRICKLER RATCHET CUTTER
"Lathe Type Cuts"
5 sizes—2½" to 24" Capacity
Write for descriptive bulletins

THE E. H. WACHS COMPANY
Manufacturers of Engines, Valves and Machinery since 1893
1525 NORTH DAYTON STREET
CHICAGO 22, ILLINOIS

the correct basis of liability was in tort (2 years—expired), or the constitutional provision (3 years—not expired.)

The court held that the action was not in tort, as are ordinary damage claims for injuries to property, but was based on the Constitutional provision. Hence the statute of limitations period had not yet expired, and the action could be maintained. A judgment for the owner in the lower court was therefore affirmed by the Supreme Court of Oklahoma.

It should be kept in mind, however, that most state constitutions provide only that "Private property shall not be *taken* for public use without just compensation" (omitting "or damaged"). In such states, no action can be maintained for damages, except on a tort basis, and there would have to be a showing of negligence on the part of the City.

Deciding Responsibility for A Leaky Sewer

Bush Building Co. v. City of Barbourville, 155 Fed. Supp. 394, a Kentucky case decided in the Federal district court Oct. 9, 1957, was a suit by a contractor for the amount due on the construction of a sewer, i.e. $95,653.95.

The City defended on the ground that the contractor had failed to do the job properly, and counterclaimed for damages of $150,000 which it spent to repair the defects throughout the nine miles of sewer pipe constituting the system.

The contractor claimed that the engineer's certificate was conclusive, under the terms of the contract, and that the city's defense and counterclaim were therefore no good. However, the court overruled this objection, on the ground that the engineer had failed to render a fair and impartial decision on the question of excessive leaks, amounting to such fraud or gross mistake as necessarily to imply lack of good faith. At one point, the engineer told the City that the "sewer pipe joints are practically water tight". As the infiltration was found to be increasing, he raised the maximum allowable leakage from 36,960 gallons per day to 76,876 gallons per day, and finally to 117,600 gallons per day.

As a result, the City's defense and counterclaim were allowed, and the City was awarded damages equal to the difference between the $150,000 it had spent to repair the defects and the $95,653.95 it had retained against the contract price.

The "SALUTE" ad reproduced on the opposite page is one of a Byron Jackson series scheduled in newspapers throughout the United States.

IMPORTANT: A full color wall size reprint (20" x 17") of this original painting by Herbert Fillmore is available without obligation to all persons concerned with water planning and supply. Write to W. S. Thomas, Byron Jackson Pumps, Inc., Box 70B, Lawrenceburg, Indiana or ask your nearby BJ Pump office.

TWO PIECE
sliding or screw type cast iron valve boxes for covering 4" thru 10" valves for water or gas. Rugged construction for lifetime service. 5¼" shaft. Extensions as required.

Adjustable
VALVE BOXES
THREE PIECE

valve boxes supplied with separate bases are available in sliding or screw type. Made with 5¼" and 7" shafts with extensions as required. Complete line of service and roadway boxes.

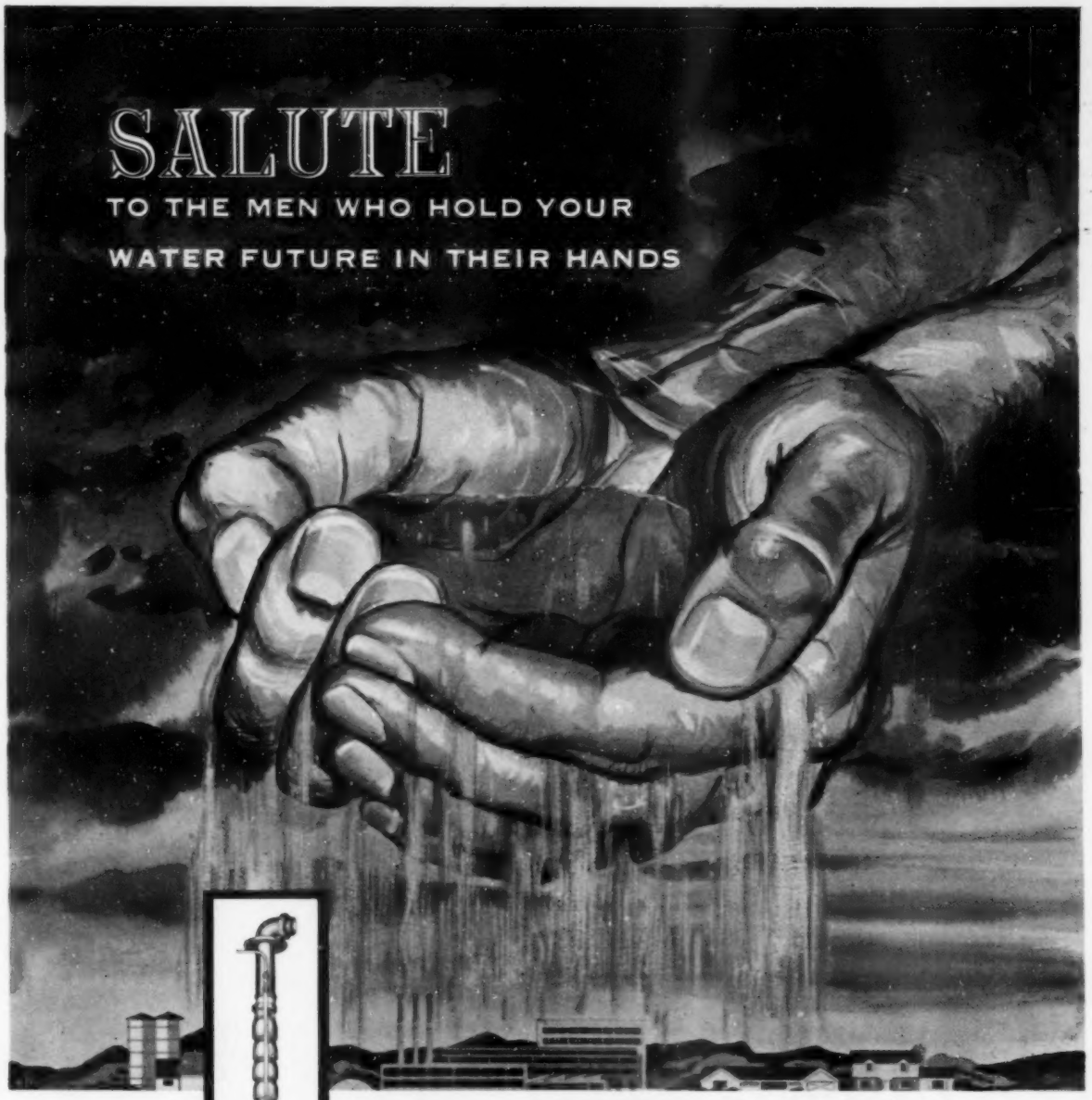
ALABAMA PIPE CO.

We Invite Inquires to Our Nearest Sales Office
120 S. Michigan Ave. / 350 Fifth Avenue
Chicago, Illinois / New York 1, New York
General Sales Offices
ANNISTON, ALABAMA

APCO

SALUTE

TO THE MEN WHO HOLD YOUR WATER FUTURE IN THEIR HANDS



The BJ Submersible shown here combines motor and pump in one powerful package that quietly works out of sight and sound. It is one of the modern answers to water supply pumping.

SINCE 1872

AT THE TURN of a tap... the indispensable fluid called water flows to keep our homes and community healthy and clean... our farms and industry prosperous and productive.

But today's life-giving water is not the instant servant it seems. Your local officials and water department—and the consulting engineers and pump dealers who work with them—have planned and built years in advance to put this water "on tap." *These men hold our water future in their hands.* Help and support them in this vital work.

BYRON JACKSON PUMPS

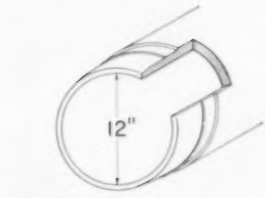
A Subsidiary of Borg-Warner Corporation · P.O. Box 70, Lawrenceburg, Indiana

Now! Transite Sewer variety

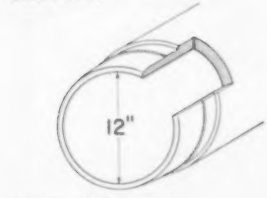
Transite's Ring-Tite® Coupling is designed for high-speed assembly . . . presents no problem in joining lengths of varying crushing strengths or diameters.

CLASS 1500—

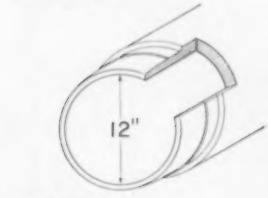
CLASS 2400—



CLASS 3300—



CLASS 4000—



CLASS 5000—

Transite Sewer Pipe now classed by Standardized Crushing Strengths

Based on A.S.T.M. 3-edge bearing method (strength in lbs. per lineal foot)

Size Inches	Class 1500	Class 2400	Class 3300	Class 4000	Class 5000
6	1500	2400	3300	—	—
8	1500	2400	3300	—	—
10	1500	2400	3300	4000	5000
12	1500	2400	3300	4000	5000
14	—	2400	3300	4000	5000
16	—	2400	3300	4000	5000
18	—	2400	3300	4000	5000
20	—	2400	3300	4000	5000
24	—	2400	3300	4000	5000
30	—	—	3300	4000	5000
36	—	—	—	4000	5000

Pipe is available in a wide of new crushing strengths

Progressive new concept permits greater efficiency in sewer design . . . reduces overall costs through closer matching of crushing strengths to needs!

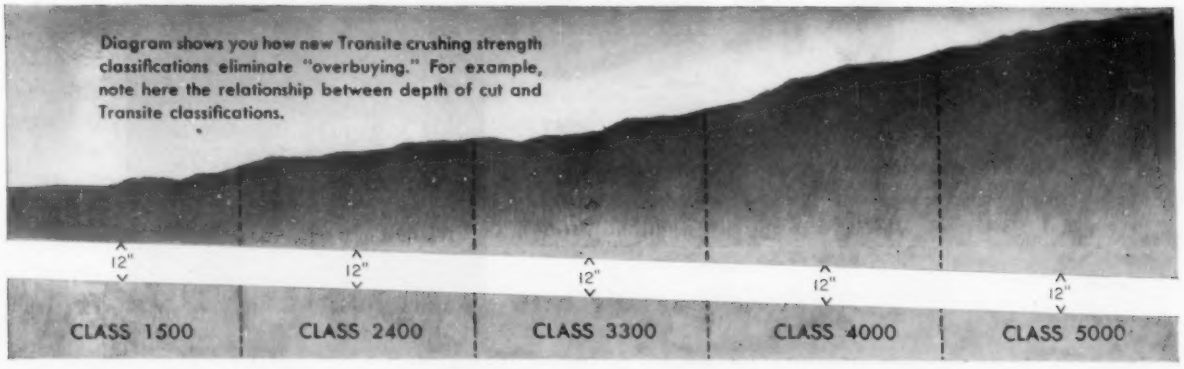
HERE'S THE BIGGEST sewer pipe advance in years! In a revolutionary move, Johns-Manville introduces five new sewer pipe classifications to greatly simplify accurate sewer pipe specification . . . permitting overall cost saving to a degree never before possible.

Through improved manufacturing methods, Johns-Manville brings you Transite Sewer Pipe in a variety of the more widely needed crushing strengths: 1500, 2400, 3300, 4000, and 5000 lbs. . . . in 11 different diameters ranging from 6″ to 36″ (*see chart*).

Permits greater efficiency in system design. To the engineer, the new Transite crushing strengths mean new ease in achieving greater efficiency in sewer design. For now he can plan pipe layouts as he has always wanted—selecting pipe on the basis of depth of cut, width of trench, type of soil and manner of bedding. The result: far greater overall economy through use of more realistic safety factors . . . reduction in the need for over-design . . . with costly concrete encasement and cradling needed in fewer areas.

Let us send you TR-94A, Sewer Design Flow Chart and DS-366, Transite Specifications. Write Johns-Manville, Box 14, N.Y. 16, N.Y. In Canada, Port Credit, Ont.

JOHNS-MANVILLE



C.-A.-P. SYSTEM®

filter gauges and controllers give you 3 important advantages

1. *Positive Controlled Air Pressure*
2. *Instant, accurate measurements of head and flow . . . plus automatic flow control*
3. *Elimination of troublesome cables, piping, stuffing boxes or accessories*

The superiority of the "C.-A.-P. SYSTEM" instruments results from positive controlled air pressure produced by a simple, compact, dependable mechanism. This simplicity contributes to extreme accuracy and rugged construction — economical operation and long life.

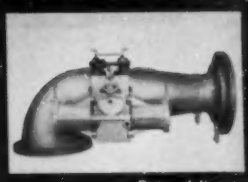
The overall advantages to you include greater efficiency throughout your operation and savings in both time and money.

Whether you are installing a new plant or modernizing an old one, investigate the many advantages of INFILCO equipment.
For full information write today for Bulletin 1100.

Inquiries and samples are invited on all water and waste treatment problems for municipalities, institutions and industry.

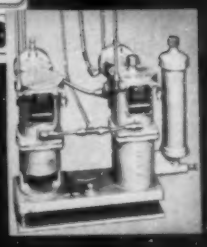
INFILCO

C.-A.-P. SYSTEM Instruments



Rate of flow controller is accurate and dependable

Loss of head and rate of flow indicator and recorder is simple and easy to read



Converters may be mounted in convenient location

Typical operating console is compact and accessible

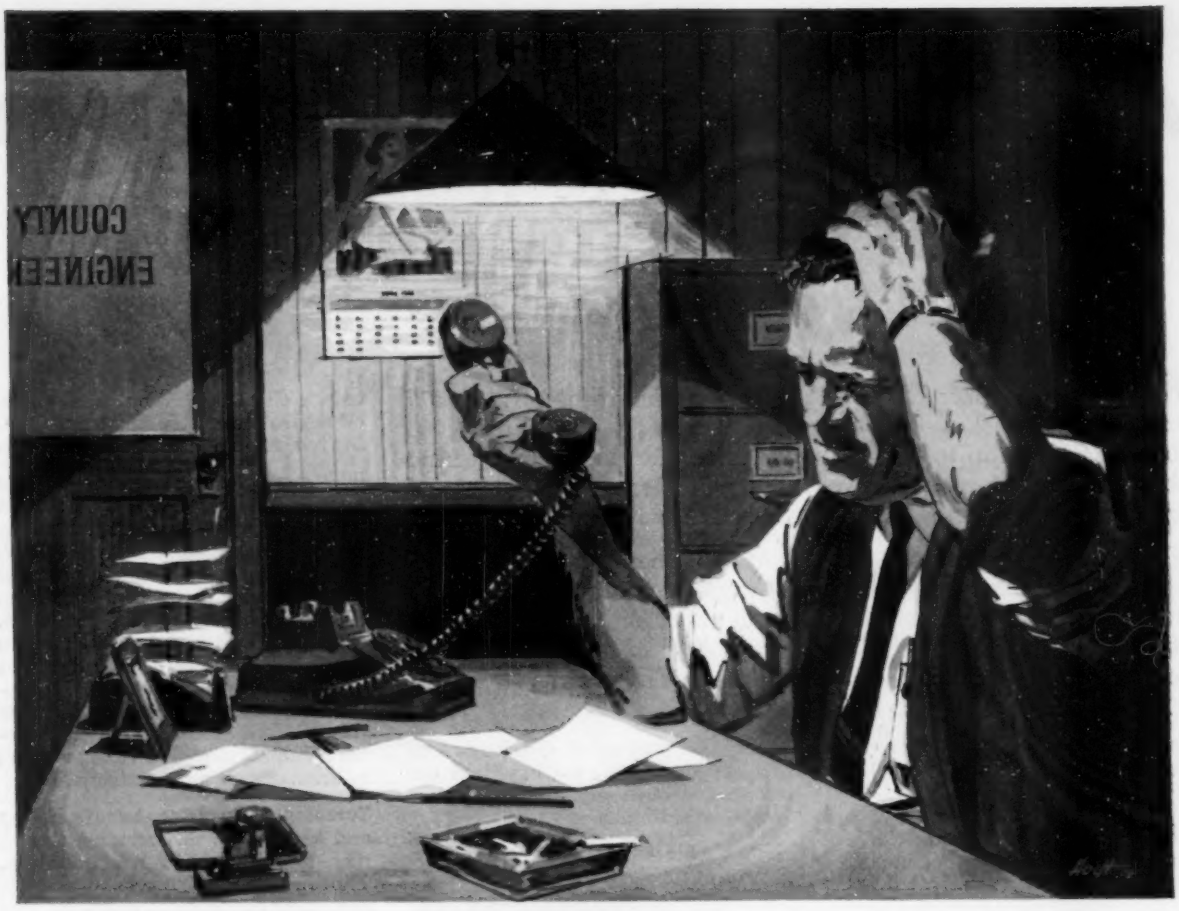
INFILCO

General Offices - Tucson, Arizona - P.O. Box 5033

Field offices throughout the United States and in foreign countries

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

57417-A



End Maintenance Complaints! Salt Stabilize Your Gravel Roads

Build better roads that keep everybody happy by stabilizing with Morton Salt

As a wearing course, salt stabilized roads give motorists a smoother, safer ride and create less dust. When you stabilize with Morton Salt you get the added satisfaction of putting in roads with durable surfaces which reduce frost action, minimize loss of expensive aggregate (the savings in aggregate alone more than pay for the salt), and require far less maintenance.

As a base course, Morton Salt stabilized roads form an ideal bond with most types of bituminous material. With added stability, increased load bearing strength, improved bond and controlled frost action, salt stabilizing reduces the need for most costly and heavier surface courses.

Please send me
your free booklet
on salt stabilized roads.

Name_____
(Please print)

Title_____

Address_____

City_____ Zone____ State_____

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. PW-4-58, 120 So. LaSalle Street,
Chicago 3, Illinois

Now! The greatest concentration built into a truck engine!

Ford's all-new Super Duty V-8's—with displacements of 401, 477 and 534 cubic inches—are designed to handle GVW's up to 51,000 lb. and GCW's up to 75,000 lb. on America's toughest runs. And their endurance has been proved, not only in dynamometer labs and on the proving grounds, but in commercial fleets from coast to coast.

You get more miles with less downtime! These all-truck engines combine an entirely new concept of engine cooling with the latest developments in mechanical design and materials, setting new Ford standards of performance and dependability in heavy-duty truck service. Here is the "how and why" of Ford's superiority:

Exclusive three-stage cooling provides fast, uniform warm-up. Coolant flow is controlled by a second thermostat that balances the rate of warm-up and expansion of block and heads. Stress concentrations and the possibility of head warpage are virtually eliminated.

High-capacity water pump, the heart of Ford's cooling system, circulates over 200 gallons per minute. High volume coolant flow, with little or no aeration, supplies vital scrubbing action at valve guides and seats. Another advantage of this unique pump—its high capacity (50% more than competitive types) is obtained with no increase in required horsepower.

Water-jacketed fuel-air intake passages, in manifold *and* heads, maintain correct and uniform fuel temperatures from carburetor to combustion chambers. This results in proper vaporization and equal distribution of fuel-air mixture to each cylinder for improved economy and maximum engine smoothness.

New "In Block" combustion chambers transfer heat concentration from heads to block for 360° chamber cooling. This transfer allows better cooling of head and valve areas, greatly increasing the life of these parts. Combustion heat absorbed by the head of the aluminum alloy piston is transferred to the long, solid piston skirt. From there it is readily dissipated through the cylinder wall into the coolant which surrounds cylinder throughout the entire length of piston travel. The result is long life pistons and rings.

Internally mounted oil cooler keeps oil at lower temperatures for better lubrication. Reduced oil temperatures maintain greater oil film strength and reduce oil carbonization. Also, cooler oil means cooler running, longer lasting rod, main and camshaft bearings.

Fully machined combustion chambers mean close tolerances for accurate regulation of compression pressures. In Ford's new Super Duty V-8's, all surfaces of the combustion chamber (cylinder wall, bottom of head and top of piston) are precision-machined. Piston tops have a tapered step to maximize turbulence for improved combustion with regular grade gasoline. The smooth, straight surfaces of this wedge-shaped combustion chamber eliminate deposit-forming pockets to minimize harmful preignition.

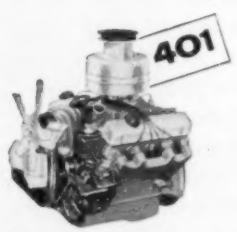
Turbulence Top pistons have four rings and three of them, including the oil ring, are chrome-faced for long life. The top ring groove has a bonded cast-iron insert to further reduce wear. Piston tops are extra thick to withstand high compression pressures. Each piston contains thermal struts that control expansion for a precise fit, hot or cold.

Hard-faced intake *and* exhaust valves with wear-resistant valve seat inserts are a Ford exclusive. Valves are made of heat-resistant materials and heads are dish-shaped to allow them to seat readily. To minimize the possibility of sticking, valve stems are electrolized, a surface treatment previously restricted to aircraft engines. Positive rotators provide a self-cleaning action for

NOW!
Three all-new all-truck V-8's

277-hp Short Stroke V-8 . . .
Torque: 490 lbs-ft @ 1800-2300 rpm

260-hp Short Stroke V-8 . . .
Torque: 430 lbs-ft @ 1800-2300 rpm



226-hp Short Stroke V-8 . . .
Torque: 350 lbs-ft @ 1800-2300 rpm

American Business buys more Ford Trucks than any other make!

# of endurance features ever

They're all standard in Ford's new Super Duty V-8's

more perfect seating and sealing. Any valve material requires good cooling for long life. Ford's new Super Duty engine design makes more coolant available for lower valve temperatures. This coolant flowing past Ford's integral valve guides quickly carries away valve heat. In addition, exhaust valves are sodium-filled for rapid transfer of heat from head to stem. The sodium is added by a unique process that eliminates welding, thereby strengthening the valves.

Hot testing of every Super Duty V-8 is a typical example of Ford's quality control. Each engine is run for 20 minutes to check smoothness, timing, valve lash adjustment, oil pressure, and push rod rotation.

The engine is then partially disassembled. Parts are inspected for condition and alignment. Special attention is given to bearings and other items that might cause premature failure. The engine is then reassembled and run for about 10 minutes to check timing, noise level, acceleration, smoothness and coolant, oil or compression leaks. Only Ford uses such a detailed inspection of every engine. This is done to provide you with a more dependable truck.

New submerged electric fuel pump virtually eliminates vapor lock and maintenance problems. Mounted in the bottom of the tank, it pushes solid fuel under pressure from tank to carburetor. Its electric motor is sealed in a stainless steel capsule, and operates the pump by magnetic drive.

Every engine part is a truck engine part designed and built exclusively for Ford's all-new Extra Heavy Duty trucks. The same attention to detail required for durability in the major components has been carried over to all other parts as well. Listed below are but a few typical examples:

Stainless steel gaskets at heads and exhaust manifolds practically eliminate tie-ups due to blown gaskets.

No external oil lines to break. Oil filter and air compressor are mounted directly to block.

Valve stem seals are of same material developed for use in government missile program.

Rotor-type oil pump maintains high output, virtually unaffected by normal wear from extended operation.

Dual exhaust system provides far easier breathing and higher volumetric efficiency.

Alternator system replaces generator for longer electrical life.

Biggest Ford trucks ever built! Ten new series—Tilt Cabs, Conventionals, Tandems—up to 51,000-lb. GVW, 75,000-lb. GCW. For complete information see your local Authorized Ford Dealer.

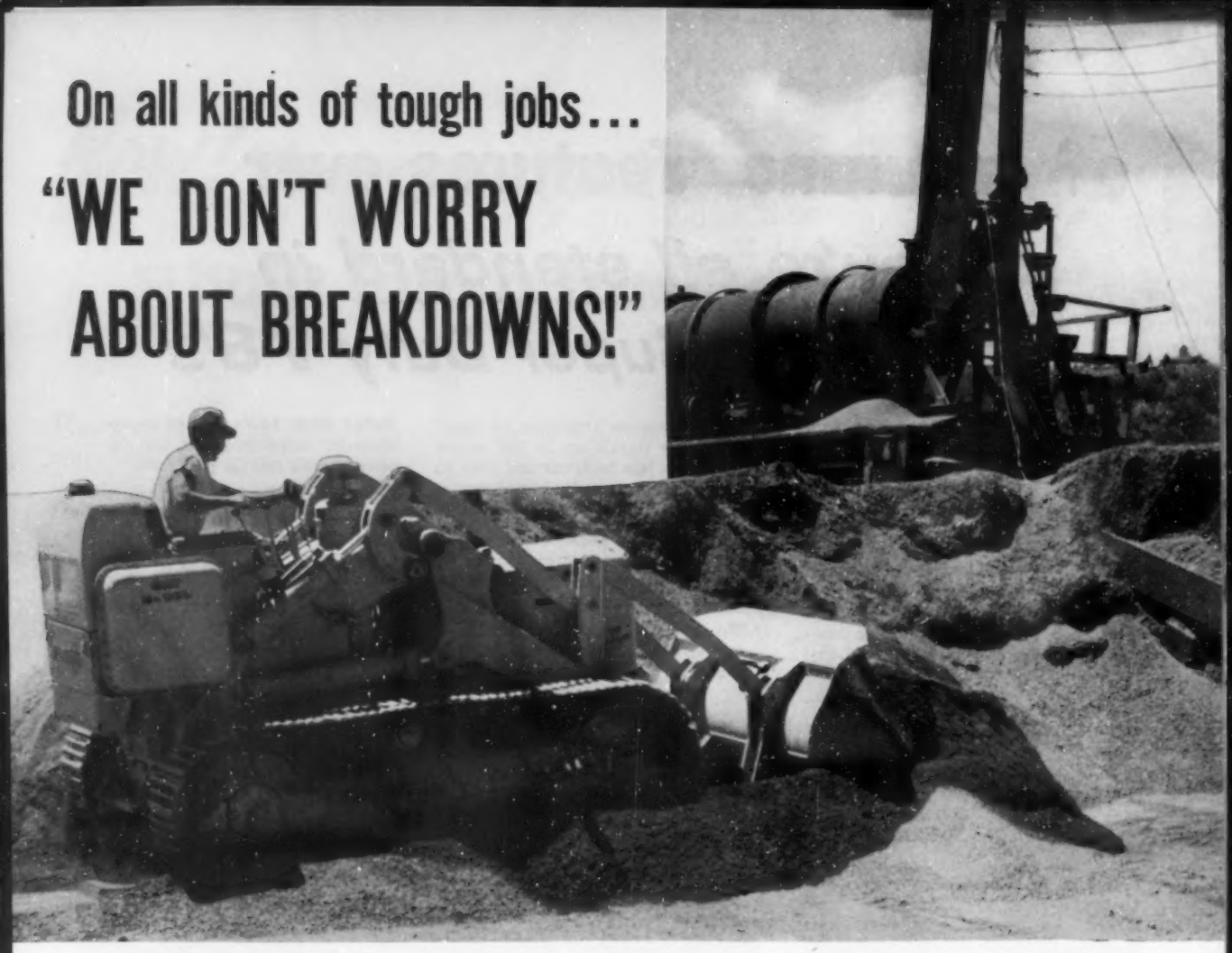
Big truck built... big truck powered... at Ford's low prices!

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . LAST LONGER, TOO!

On all kinds of tough jobs...

"WE DON'T WORRY ABOUT BREAKDOWNS!"



CAT* No. 955 Traxcavator feeds ⅜ minus aggregate at asphalt plant near The Dalles, Ore. "This is a real all-purpose machine," says Supt. Jim Manes.

That's a Caterpillar No. 955 Traxcavator* going eight hours a day at an asphalt plant for the City of The Dalles, Oregon. Jim Manes, Street & Sewer Supt., chooses Caterpillar for several reasons. He likes the Traxcavator for its versatility, and its easy-handling controls. "Our No. 955 Traxcavator operates economically and it does a multitude of jobs. *And we don't have to worry about breakdowns.* We've run it now for a year with practically no upkeep. In fact, our experience with Cat-built equipment has been a story of low-cost maintenance."

You need trouble-free performance on *your* jobs, too. It's built into every pound of the three Traxcavator models your Caterpillar Dealer offers. In any size—1 to 2¼ cu. yd. buckets—you get quality construction, fast-acting hydraulic controls, exceptional visibility. The heavy-duty Series E model is available in each size, too, for those tougher jobs that put extra strain on your equipment.

Seeing's believing, so see for yourself on *your* jobs how versatile, how productive and how efficient the Traxcavator is. Call your Caterpillar Dealer for a demonstration of your taxpayers' best equipment investment. And you'll like his follow-up with round-the-clock service and parts you can trust.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

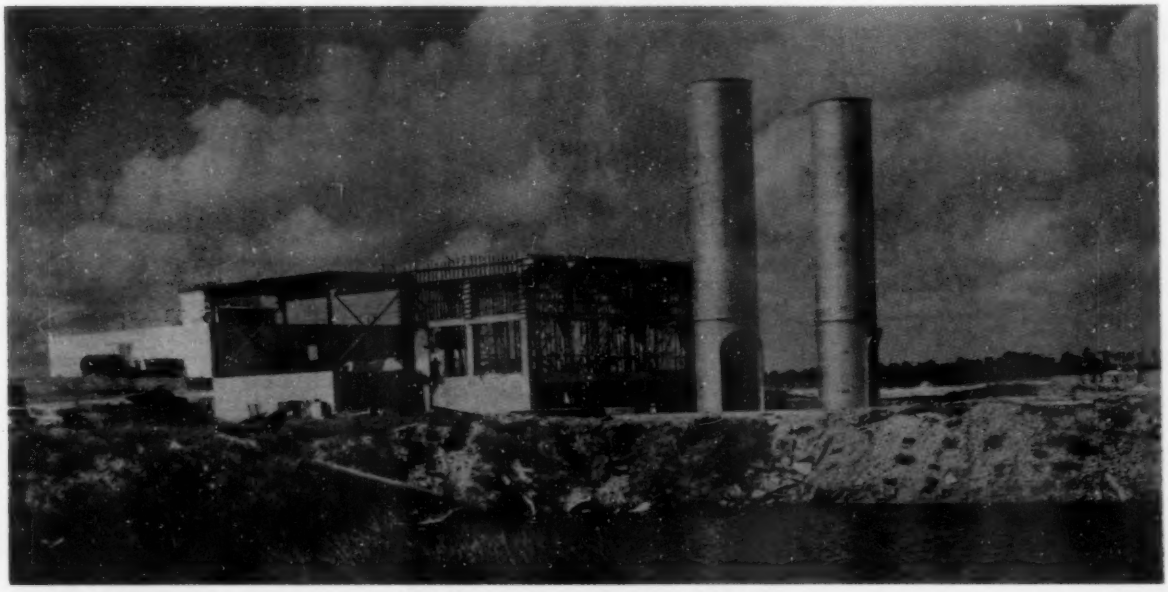
CATERPILLAR*

*Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

YOUR TAXPAYERS GET THEIR MONEY'S WORTH WITH CAT-BUILT MACHINES

PUBLIC WORKS Magazine

Vol. 89, No. 4 APRIL, 1958



● INCINERATOR under construction, showing 65-ft. stacks, framing of main building and pond. Lot dimension is 190 by 330 ft.

New Incinerator Designed to Reduce Fly Ash Emission

COL. JOSEPH W. WATSON,
City Manager,
Hollywood, Fla.

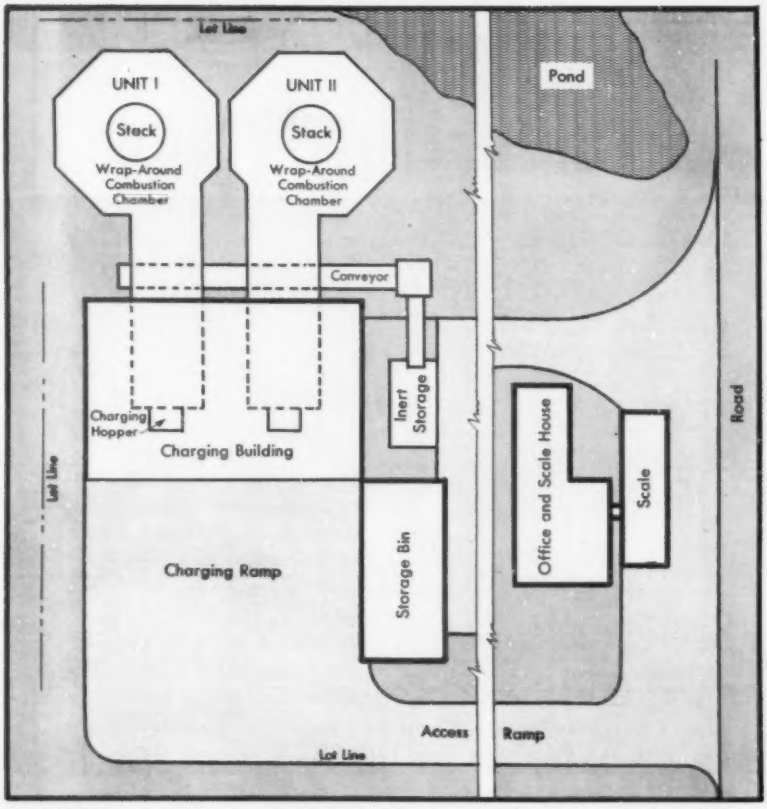
IN THE 450-ton incinerator now under construction for Hollywood, Fla., extreme care has been taken to eliminate undesirable discharges from the stacks. Separation of fly ash from the inerts, for ease in handling and possible sale, is by means of a wire mesh conveyor and a special solids handling pump; also ash removal from the settling chamber is by a new type of pump. Scheduled date of completion of the incinerator is mid-summer 1958.

The approximate cost of the plant will be $670,000. Smith & Gillespie, Jacksonville, Fla., consulting engineers, prepared the designs, plans and specifications. Carl F. Widell & Son of Hollywood is prime contractor for building construction; the furnaces and stacks are being built by Pyro Incinerator Corp., Long Island City, N. Y.

The site available to the city for the plant was small in area—190 ft. by 330 ft., and partly occupied by a pond—for an incinerator of the size required and to incorporate the entire facility on the site required the utmost ingenuity. An estimate of the refuse likely to be generated indicated a minimum plant size of 300 tons per day; however, it was determined that a 450-ton plant would lower the labor cost per ton of refuse incinerated without increasing materially either space requirements or the initial investment. The larger units will permit elimination or reduction of overtime work.

The plant consists of an office and scale house at the plant entrance; a ramp up which the loaded trucks proceed after weighing; a charging floor; a high capacity vibrating grate stoker; ash handling facilities; and a 75-ton covered storage bin. There are two furnaces, each having a capacity of 225 tons per day; and two stacks, 65 ft. high which are designed to withstand 150 mph winds. Provision is made at the gate house for checking the characteristics of the refuse, and a public address system provides the charging floor attendants with information regarding the arriving loads.

After dumping on the charging floor, the refuse will be sorted, blended and charged into the furnaces by a gasoline driven push truck. Feed is through electrically operated charging gates to the stoker level. The 75-ton storage bin at the corner of the building



● **LAYOUT of incinerator showing pond in upper right corner, stacks, charging building and ramps, storage facilities, office and scale house and scale location.**

provides storage for start-up fuel and for refuse which, during peak load periods, may be brought in at a rate greater than can be immediately handled on the charging floor. It is not anticipated that this bin will be used very much during early years of operation.

Temperatures

Furnace temperatures, which will be held at about 1800°F, will be automatically controlled by the amount of excess air admitted and also by the rate at which the refuse progresses along the grate. Underfire air, controlled in three zones, and admitted through cast iron tuyeres built into the burning area of the grate, keeps the fuel bed agitated. The balance of the air required for combustion and temperature control enters the chamber through adjustable side wall air ports about 4½ feet above the grates. The burning gases travel over the bridge wall into the secondary or settling chamber, the spread of the gases being kept at a rate low enough to prevent excessive fly ash entrainment.

Upon entering the settling chamber, the hot gases are split to force half the gas on either side of the stack. This is accomplished by wrapping the settling chambers around the stacks. The divided flow is slowed down to drop heavier particulate matter. The gases next pass through a baffle port; and immediately thereafter are struck by air jets which drive out finer particulate matter. On the floor, special waffle blocks pick up the fine materials, which are trapped, deposited on the wet bottom, and removed to the water troughs by means of sprays. This procedure is repeated twice in order that the discharged gases be practically free of particulates, but remain at a temperature high enough to provide sufficient draft to insure proper furnace operation.

The ash and other inert matter, upon leaving the stoker bed, drop onto a wire mesh conveying belt. The ash passes through the mesh into the washing trough; the cans, bottles and larger inert particles travel on the conveyor through high pressure water sprays which cool them and remove adhering ash. The belt, rising at an angle, moves this coarser material into the overhead storage bin. Cleats are placed on the belt to prevent roll or slipback of the material; and a motor interlock stops the belt if a jam occurs, operating an alarm.

The fly ash collected in the settling chamber is washed into the trough whence it is pumped outside of the building for centrifugal separation. Since the temperature in the settling chamber is about 1600°F, provision had to be made to prevent evaporation of the flushing water. This is accomplished by the use of waffle blocks so placed as to form a water way outlet, whence the material is pumped to the separators for final disposal.

Construction of motor vehicle maintenance facilities will be started soon on the north side of the incinerator. By this means, all equipment associated with trash and garbage removal will be concentrated for maintenance and storage adjacent to operations. It is believed that the mechanical force operating at night can effect maintenance on both the incinerator and the rolling equipment.

Equipment and materials used in this plant were furnished by the following: Roof arches, M. H. Detrick Co.; refractories, Mexico Refractories Co.; blowers, American Blower Co.; motors, U. S. Electrical Motors, Inc.; instruments, Minneapolis-Honeywell Co.; conveyors, Stephens-Adamson Mfg. Co.; charging gates, Beaumont Birch Co.; oil burners, North American Mfg. Co.; all other equipment and stacks, Pyro Incinerator and Supply Co.

Jarrett C. White is City Engineer of Hollywood. George A. Childress is project manager for Smith & Gillespie, with Thomas A. McGee, chief designer and Horace P. Edmond, resident engineer.

AS A SERVICE TO OUR READERS . . .

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The Editor, PUBLIC WORKS,
200 South Broad St.,
Ridgewood, N. J.

NEW PRODUCTS

Reduce Sewer Project Costs

CHARLES R. McKEE,
City Manager,
Rogers City, Michigan

Installation of a prefabricated lift station and use of vitrified clay pipe with plastic joints solve difficult river crossing.

RAPID POST-WAR growth in Rogers City resulted in a serious sewer extension problem. The problem was complicated by the necessity of a lift station, a river crossing and a high ground water table. The lift station capacity requirement was 200 gpm against a total dynamic head of 27.8 feet. Both the conventional poured concrete lift station and the prefabricated factory tested pumping station were considered for this purpose. The former, although widely used, presented certain problems. Such an installation would by its very nature require the coordination of various trades; this factor would result in multi-responsibility, and unknown cost and uncertain completion dates. The package station, on the other hand, would be the responsibility of a single agency. Its cost could be determined before the order was placed. The installation was simple and would require only a few days. Furthermore it could be located within the street right-of-way without the detriment to traffic and abutting property that could develop with the poured station.

For the above reasons we purchased the 7 ft. by 7 ft. cylindrical, corrosion-protected steel pumping chamber and 3-ft. entrance tube containing two bladeless Fairbanks-Morse sewage pumps operating alternately, except under severe loading when they would run simultaneously. Check valves maintain continuity of flow and the manual valves permit removal of either pump from service for maintenance. A prewired panel containing pressure sensitive devices controls the alternation of the pumps and actuates them when the sewage in the wet well reaches predetermined levels.

The dehumidifier which maintains the electrical and other equipment in good operating order and a sump pump to evacuate water from minor leakage and washing down operations are located under the ladder. A switch connected to the manhole cover turns on the lights and a blower when the station is entered thus maintaining a fresh air supply in the chamber.

A photograph taken with a wide angle lens looking directly down shows the interior of the station. We feel that the unit which has been in operation for over a year was an excellent choice. It was designed and built by Schmieg Industries Inc., of Detroit.

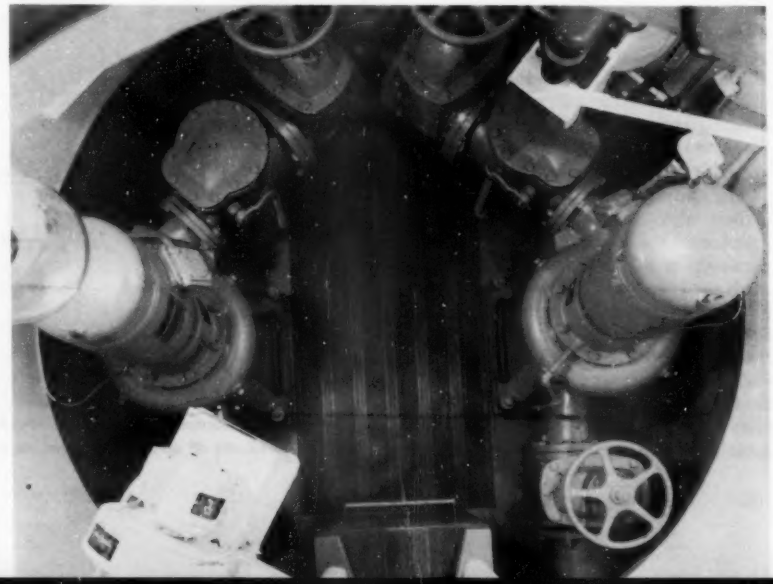
Alternate Plans

The Trout River crossing could have been accomplished by a high level sewer suspended beneath the bridge, by an inverted siphon under the river on the high level line or by a low level sewer beneath the bed of the river. Factors taken into consideration were the possibility of freezing and damage by floating ice, debris and vandals to the suspended sewer; difficulty of installation and maintenance of the siphon; and the difficulty of installation of the low level sewer. The low level alternative was chosen as being the most practical and economical. The lift station and wet well site was excavated and shored with steel piling to a depth ten feet below and adjacent to the river bed. We had anticipated that a well point system would be necessary to keep this excavation and the sewer ditches dry. Use of sheet piling at the station and wet well site and American Vitrified plastic joint pipe in the sewer trenches, however, enabled the work to proceed at a rate where pumps operating in the excavations held the water to a workable level.

The river crossing was made at the lowest stage at which time the entire flow was diverted between the center and north bridge abutments while the line was laid between the south and center abutments. This process was then reversed and the other half laid. The line was encased in concrete through this area to protect it and to prevent weakening of the bridge foundation.

William A. Gross, a local contractor, made the entire installation with excellent workmanship and adherence to specifications throughout. Infiltration on the 3300 feet of sewer was a mere trickle and our experience with a year's operation has convinced us that we have throughout a well designed and constructed addition to our sewerage system which was obtained at very reasonable cost.

● **PREFAB lift station, 8 ft. in diameter, has matting on floor, blower for ventilation, two pumps, valves and ample space for any necessary maintenance work.**



Metering to Establish Distance

MELVIN P. HATCHER,

Director of Water Department,

Kansas City, Missouri

MOST ELECTRICAL power service is sold on a two-part rate basis. That is, the total charge for service includes a charge for maximum demand and a separate charge for the total amount of power used. As far as the author has been able to learn, Kansas City has pioneered the use of a two-part rate for water service. Such a rate has been applied to the major part of the City's suburban water service since October 1, 1948. Kansas City believes it has proven the practicability of this rate plan for users of water in the larger quantities. In the fiscal year ending April 30th, 1957, the revenue from service under this two-part rate—called the Suburban Demand Rate—was $1,259,625. This revenue averaged 17.9¢ per 100 cubic feet and accounted for 20 percent of the total revenue from all water sold.

Actually Kansas City's demand rate as applied to water service goes one important step beyond electric power rates. It includes a factor for distance—in this instance the distance from main pumping stations to the point of delivery. An earlier description of the rate plan was given under the title "Distance and Demand Factors in Suburban Water Rates," *Jour. A.W.W.A.*, November, 1950. The distance factor is in recognition of a point not too often brought to light in water rate practice; namely that the transportation of water accounts for a substantial part of the cost of water service. In Kansas City this cost—that is fixed charges on trunk mains and not including pumping expense—accounts for about 25 percent of the cost of service to suburban users of water.

The application of the rate requires equipment that will record graphically the flow of water through the customer's meter or meters. Kansas City has used the equipment of two manufacturers—one, the Meter Master manufactured by F. S. Brainard and Co. of Hartford, Connecticut, and the other, the recording equipment of Neptune Meter Company designed for attachment to its own meters. Each of these two recorders and a sample chart for each is shown in Figs. 3 to 6. The author understands that there are other recorders of this type but has not used them.

The need for the distance-demand rates is related to the character of Kansas City's water service to industries and water sales agencies outside its borders. The Kansas City system provides water service to about 660,000 people. Of this number, about 495,000 are residents of Kansas City and are served from City-owned mains. With negligible exceptions, Kansas City renders no direct service to the regular type of consumers outside its borders. The 165,000 people living in areas outside of and adjacent to the City are served through distribution systems owned and operated by private water companies, public water supply districts and developers.

There are 20 of these agencies purchasing water from the Kansas City system through 30 separate metering stations. Most of these stations are at or near the city limits, ranging at distances of 1.4 to 12.8

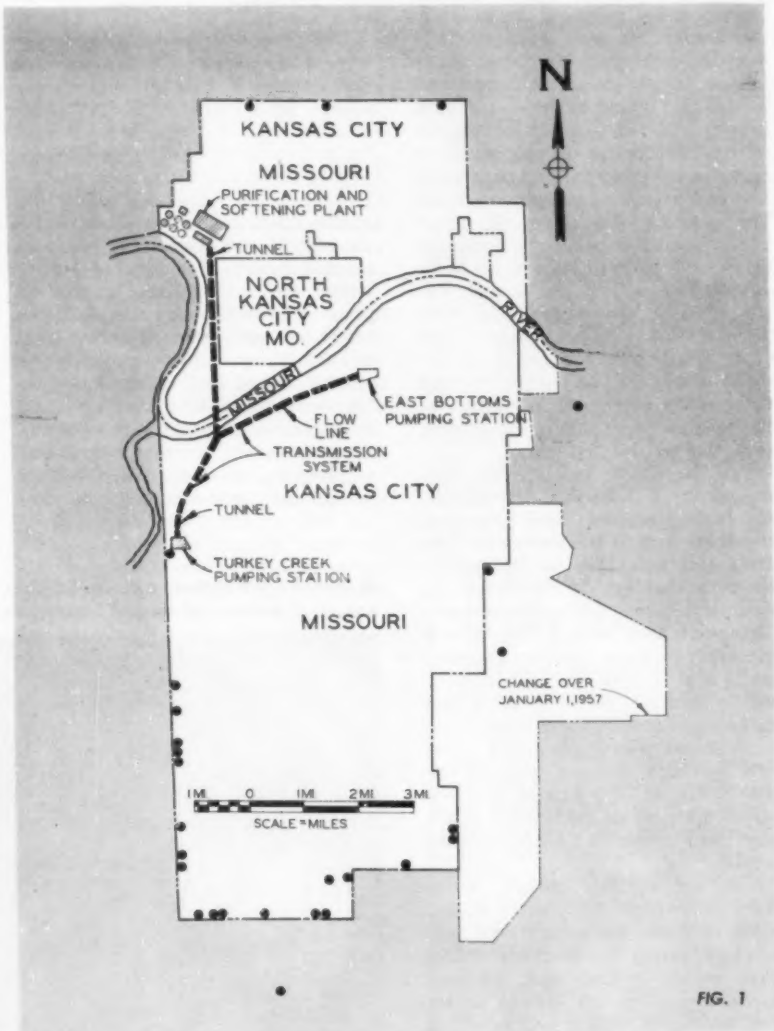


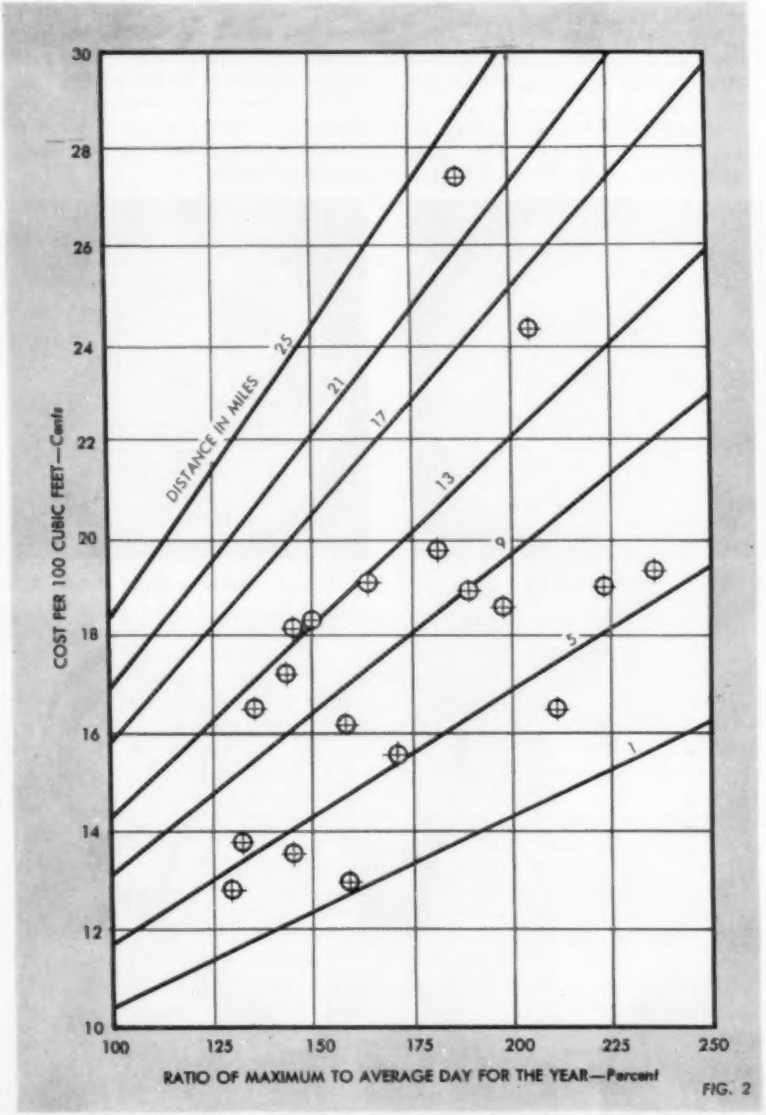
FIG. 1

● **PRINCIPAL elements of Kansas City, Mo., water system. Dots show the suburban points of purchase of water; 20 agencies purchase water through 30 separate outlets.**

-Demand Water Service Rates

miles and averaging 7.8 miles from the main pumping stations as shown in Figure 1. In addition Kansas City has extended trunk mains beyond its borders in a few cases. In two such cases these serve airports on opposite sides of the metropolitan area, and these two points of purchase are 45 car-travel miles apart. The distance factor in the distance-demand rate is designed to insure a proper distribution of the cost of transporting water from the main pumping station to these widely-separated points of purchase.

Then, in addition, the load factor varies over a wide range. In those areas that are predominantly high standard residential, the ratio of the maximum to the average day for the year (the inverse of load factor for convenience) will be as much as 300 percent, or three to one. This ratio is reduced to 125 percent to 150 percent in areas having smaller lawns and more commercial or industrial service. The maximum daily demand is a measure of the need for the capacity of certain production and transmission facilities and the fixed charges on these facilities account for better than one third of the cost of water service in Kansas City. It is important, therefore, that these costs be distributed in an equitable way, and that is the purpose of the maximum demand charge.



● **CHARGES for water are based on five factors. One of these is the maximum daily demand in any 24-hour period; another is distance. See the text herewith.**

The further explanation of the mechanics of the demand rate plan will be helped by reference to the sample calculation of charges under the rate as shown in Table 1. As will be noted, the rate includes five individual charges which are explained as follows:

(a) Maximum Daily Demand: This is a charge per month for each 100,000 cubic feet of maximum demand in any 24-hour period (not including Sundays and holidays) during the months of June to September inclusive. The demand, once established, prevails for the succeeding eleven months unless increased. The calculation of the charge includes an allowance for transportation. The current edition of the rate includes the monthly part of this latter cost at the rate of $1625 per year per mile of main per million gallons of maximum daily demand. Since the monthly charge includes a factor for distance, each point of purchase has its own maximum daily demand charge.

(b) Excess Hourly Rate of Demand: This is a charge per month for the excess of the rate of hourly demand (expressed in rate per day) from 4:30 pm to 8:30 pm and not including Sundays and holidays in the months of June to September inclusive over the prevailing maximum daily demand. This particular 4-hour evening period coincides with Kansas City's period of maximum hourly demand. The charge for the excess hourly rate of demand includes an allowance for the fixed charges on all facilities other than those accounted for in a charge for the maximum daily demand.

(c) Consumption or Commodity Charges: (1) The first step in the rate which is currently priced at 8¢ per 100 cubic feet is taken as

total consumption for the month or 10 times the maximum daily billing demand for that month, whichever is less. (2) The second step is the consumption in excess of the first step. It is currently priced at 6.5¢ per 100 cubic feet. (3) The third charge is applied only to water pumped through either of two outlying pumping stations and the price varies according to the station. This charge is designed to compensate for extra pumping expense.

As is noted above, some purchasers of water for suburban use have more than one metering station. One consumer is served with 6 stations, and this entails some extra work. Meter readings for 30 metering stations and the calculations of combined demands requires the time of about 2 men each provided with a car. It may be necessary in time to resort to a charge for each meter to cover this expense.

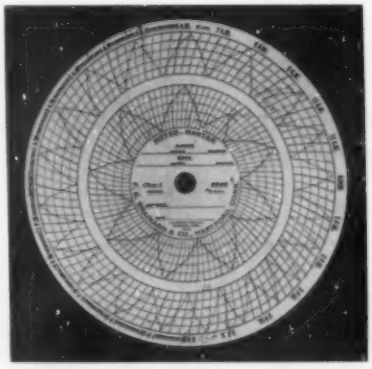
Kansas City has had 9 years' experience with the distance-demand rates. They were adopted when the maximum daily demand under the rate was about 7.5 million gallons per day. They now apply to service having a maximum daily demand of about 25 mgd. The rate has been increased on three occasions with very little change in the mechanics of the rate plan. One dividend from the rate deserves special mention. The rate provides an excellent control on the maximum hourly demand. Purchasers find it quite to their advantage to rely on storage during the 4:30 pm to 8:30 pm period. This advantage is explained in greater detail in an article appearing in *Jour. A.W.W.A.*, June, 1957.

If customers' experiences with the cost of water are to be compared, it appears best that this be done on a basis that excludes the effect of the maximum hour and that of extra pumping cost. These two factors account for about 10 percent of total revenue from this class of service. The maximum hourly charge should be excluded for the reason that the customer can control the amount of the charge by storage. Extra pumping cost is an extraneous charge insofar as comparisons are concerned.

Therefore the experiences of all full-year customers for the fiscal year ending April 30th, 1957 are compared in Figure 2 on a basis that excludes the charge for the maximum hour and the charge for extra pumping. Each crossed circle in the drawing represents a single customer's total cost of water per 100 cubic feet on this basis. Moreover, each circle shows the total cost in terms of that customer's yearly load factor—that is, the ratio of the maximum to the average day for the year—and in terms of the distance of that customer's point of purchase from the nearest main pumping station.

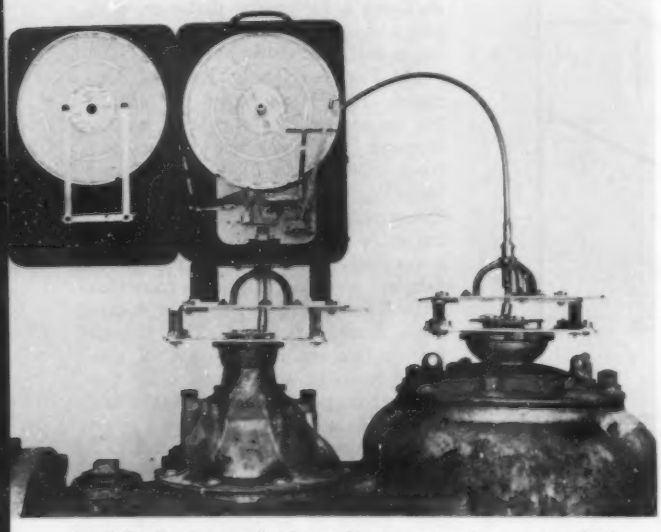
Table 1—Application of the Kansas City Rate Plan

	Quantity cu. ft.	Rate per 100,000 cu. ft.	Rate per 100 cu. ft.	Cost
Maximum daily demand	46,000	$1,800		$828
Excess hourly demand	24,000	1,200		288
Consumption	460,000		$0.08	368
	620,000		0.065	403
	1,080,000		0.025	270
Total				$2,157



● FIG. 3—Brainard meter chart.

● FIG. 4—Neptune meter chart.



● FIG. 5—Brainard Meter Master recorder as installed.

● FIG. 6—Neptune recorder for use with Neptune meters.

Sanitation Service Costs

ROY R. ROBINSON,
City Manager,
Kinston, N. C.

THE COLLECTION of garbage and rubbish together with its disposal and the sweeping and cleaning of streets comprise one of the most essential of city services. This service is also one of the most expensive items in today's budget. The Municipal Finance Officers Association reports that garbage service is one of the largest municipally budgeted items and that some cities are presently using a special charge for such service in an attempt to free tax funds from these large expenditures.

The Ohio Municipal League has compiled and published an excellent report on the "Collection and Disposal of Garbage and Refuse". This report lists the practices of 112 Ohio cities by population, ranging from 350 to 541,000, and provides a breakdown on municipal collection service and that of private haulers. Of the 54 cities reporting on municipal collection service 23 cities have a special charge ranging from $1.00 per month to $5.25 per quarter. Both the practice of using private haulers and making special charges seem less desirable from the standpoint of fairness of charge and administration.

The City of Kinston with an estimated 26,000 population and 69 miles of streets provides its citizens with deluxe service and it is doubtful that they would be satisfied with anything less. Our schedule calls for daily garbage and rubbish pickup in the commercial district and twice weekly in residential areas. There is also a special truck for pickup of wet garbage, fish scraps and dead animals. Our streets are cleaned daily in the downtown district and we attempt weekly sweeping of the most travelled streets in the residential sections.

We have from time to time had comments from our citizens and one newspaper regarding lack of attention to streets or trash pickup but we have also had numerous bouquets from out-of-town people who spoke very favorably on our generally clean appearance and on the frequent pickup of garbage and trash. It is felt that the first comments were made because of lack of comparison.

Equipment used for our service is modern. We have seven Gar Wood load packer garbage trucks of 16-yard capacity and one Leach unit of 6-yard capacity which is used for fish scraps, dead animals and wet garbage. For rubbish and trash we use four wooden body trucks, two scow and two dump body trucks. The disposal area utilizes the trench and fill method and a Caterpillar tractor does the compacting and covering. For street sweeping we have three Elgin sweepers. It requires 57 men to operate the above equipment on a 50-hour per week basis.

Many cities provide only garbage pickup while others provide for pickup of a limited amount of rubbish. In general these cities license private haulers to pick up and dispose of refuse and rubbish. It is also customary for mercantile establishments to dispose of their own paper, boxes and such types of rubbish. Kinston forces pick up and dispose of all types of refuse and rubbish, grass clippings, brush, cans, boxes, paper—in fact, anything. We have no private haulers and it has been only recently that we have refused to dispose of debris from the erection or demolition of buildings.

Costs of Collection and Disposal

During the seven months, March to September, 1957, inclusive, 23,599 cu. yds. of garbage were collected; 13,763 yards of refuse; and 6,578 yards of rubbish. The total collections of 43,940 cu. yds. cost an average of $1.43 per cu. yd. Including the picking up of 3,950 dead animals and fowls, total collection costs were $62,361.10 and the total cost of disposal was $5,636.67.

● **LATEST packer-type refuse collection body is 16-yd. capacity; seven of these are in use. Note gasoline pumps; bulk purchases of gasoline save 4 cents per gallon.**

It should be evident that these operations are expensive. Our 1957-1958 budget for the street department totals $248,220 and of this there is allocated $16,700 for street cleaning and $134,900 for trash and garbage pickup and disposal. Our sanitary land fill area consists of sixty acres and should be sufficient for ten years. It is used by county residents at no charge; also we pick up garbage and rubbish from areas adjacent to the city at a charge of $2.50 per residence per month, serving an average 200 houses.

An average of 678 miles of street were cleaned during the six months from April to September, 1957, inclusive, producing an average of 182 cu. yds. of sweepings per month, or 0.268 cu. yd. per mile swept. Cost averaged $6.53 per cu. yd., but varied from $4.60 per yard in May to $8.29 in July.

Machine Placement of Durable Asphaltic Concrete Curbs

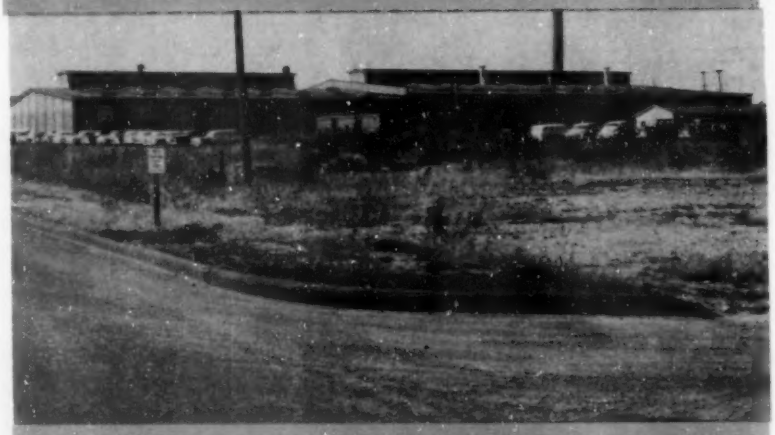
ARTHUR W. TEWS,
Chief Engineer,
Dept. of Public Works,
St. Paul, Minn.

THE DEVELOPMENT of asphaltic curb dates back to the prosperous "twenties", when street and road paving was in its infancy. My own experience with asphaltic curb dates back to the middle thirties, when several jobs were placed on T. H. 23 between Askov and Duluth, Minnesota.

Curbs on this work were placed by two methods: 1) Placing two 2-in. x 8-in. wooden forms on a 1 to 4 slope vertically, with an 8-in. opening at the top. Material was placed between the forms by hand and thoroughly hand tamped from the top. Although this method is still in use it is not very satisfactory, the results are not of the best, and the cost is much too high. 2) The machine finished type such as that used by the contractor, Megarry Bros. of St. Cloud, Minnesota, who placed a rounded semi-circular windrow on the proper alinement and then rolled the windrow with a circular shoe bolted on the right rear wheel of a farm tractor. This proved to be a most successful method of building bituminous curb. To this day the curbs placed on this project are still in perfect shape and alinement. The roadway between these curbs has been resurfaced several times and the original curb is still giving perfect service. The material used in this curb was ordinary pit run gravel, crushed to ¾-in. maximum, mixed with about 5 percent MC3, cold road mixed and hand loaded and hand placed by the contractor. This method did not develop to any great extent, and as far as I know is not being used any more.

Today there are several excellent curb machines on the market which are placing asphaltic concrete curbs rapidly, efficiently and economically in all parts of the country. The City of St. Paul last year purchased an Etnyre machine with which we have been most successful during the past year.

DeCourcy Drive was graded during the 1956-57 winter and a stabilized stone base was placed directly upon the existing subgrade, and a two course asphaltic hot plant mixed mat was placed on the stone base. The pavement is 50 feet wide between curbs, and carries all types of traffic including heavy trucks and trailers.



● **BITUMINOUS** curb has been placed at intersection which has a radius of 20 ft. In this and other pictures, note straightness and uniformity of curbing.

● **CURBING** was placed in front of two side inlet drain openings.

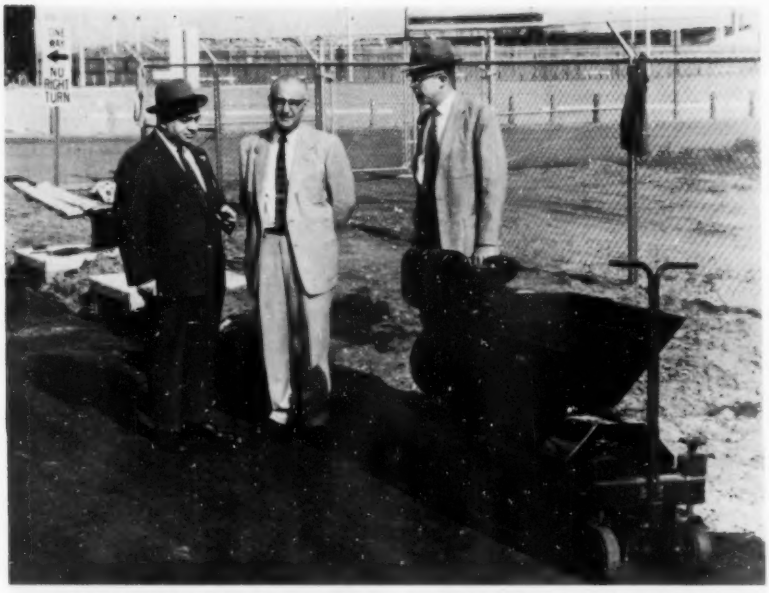
Curb was placed on each side of the pavement. The curb section is the standard 8-inch section, probably most extensively used on asphaltic mats, which are designed for future overlay construction. On residential streets having less and generally lighter traffic, a smaller and lower 6-inch curb is most generally used. This section uses less material and costs considerably less than the larger section.

The machine can place curb on radius returns for intersecting streets and driveway openings and on 20-ft. radius for side street openings. Curbs are being placed on smaller radius curves and our experience indicates that curbs can be placed successfully on a radius as small as 5 feet.

Bituminous curbs can be placed leading into side catch basins. However, this type of side inlet is not extensively used with street construction.

Placing Bituminous Curb

More specifically the procedure employed in placing bituminous curb follows a generally accepted pattern. Starting with the assumption that the pavement in place is in proper condition, with an acceptable gutter grade, the first step is to tack properly the existing pavement to insure proper adhesion of the curb. Any fast setting asphaltic material may be used for tacking purposes. The curb machine must be placed on the base, which extends at least 4 ins. beyond the back face of the curb so as to allow the curb machine to travel on the pavement base in its entirety.



● **OPERATION of bituminous curb paver is watched by F. D. Marzitelli, Deputy Com'r. of Highways; Mr. Tews; and R. L. Wheeler, Maintenance Engineer.**

The hot plant mix bituminous concrete is transferred by shovel from a truck into the open hopper of the curbing machine and from then on the machine does the rest. A gasoline powered worm gear, or screw, pushes the mix out through a mold form under compaction pressure. Automatically self-propelled, the curb paver lays curb to any desired shape—straight or curved, and travels at four to eight feet per minute, depending upon the size of the curb. One ton of mix lays 30 to 70 feet of curb, which is ironed completely smooth with a heat-jacketed mold. Curb compaction is over 90 percent which is equal to a 10 to 15-ton roll. Hot plant mix bituminous material forced through the heat-jacketed mold of the curb machine is transformed into a dense mass with a slick surface, which has a higher asphalt content in the outer half-inch area. This very highly desirable phenomena is brought about by the heat-jacketed mold, which seems to draw the asphalt to the surface.

Hot plant mix bituminous curbs have proved to be extremely durable, and have demonstrated their ability to withstand the roughest treatment. Car and truck tires coming in contact with bituminous curbs create the same effect as a roller or compactor and cause no harm whatsoever. Snow plowing and loading equipment cause very little damage to the flexible curb. Ice-melting chemicals producing free water, have no effect at all on asphaltic curbs.

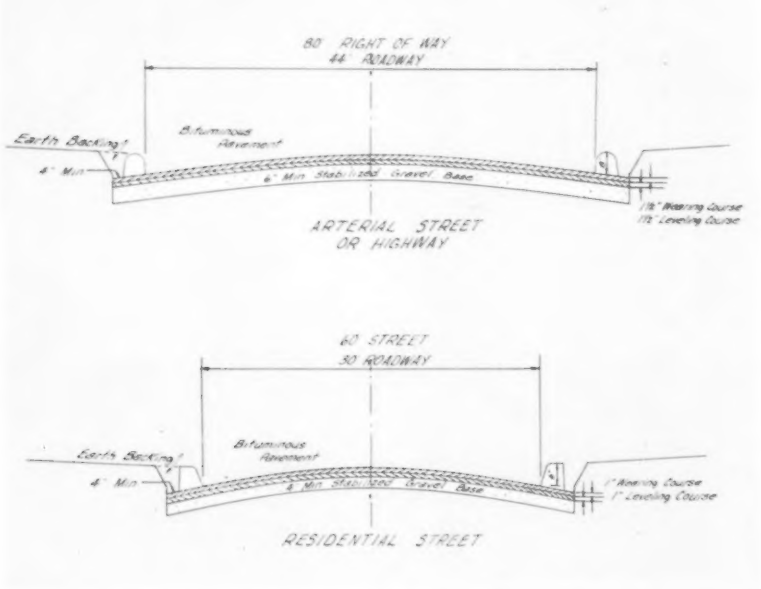
Table 1 shows the bituminous mixes that were used in 1957 on our work. The second column indicates the gradation used on the larger curb, which was 8-in. high, and the third column indicates the gradation used on the smaller curb, which was 6 ins. high.

Table 1—Bituminous Curb Mixes

Std. Sieve Size	DeCourcy Drive	Shepard Road
¾"	...	...
⅝"	100	...
½"	...	100
⅜"	86.8	94.25
#4	64.5	74.21
#10	47.7	55.58
#20	33.9	...
#40	22.1	31.0
#80	8.0	13.51
#200	3.6	7.61
% Bitumen	5.5	5.59
Pen. Grade	85-100	85-100
Marshall Stability	...	1270
Marshall Flow	...	11

Bituminous curb was placed on DeCourcy Drive during May and June, 1957, amounting to 6,522 lineal feet. The total cost was $2,930.77, or an average cost of $0.45 per lineal foot. Our average rate of curb placement was approximately 111 feet per hour, or very nearly 900 feet per 8 hour day. Again it must be remembered that this was the higher, larger section.. The total tonnage used on this job was 190 tons. One ton produced 34.3 feet of curb, at a cost of $15.40 per ton, in place. The smaller type, 6-in. in height, will use about 25 percent less material. A ton on Shepard Road produced about 45 feet of curb and the approximate cost per lineal foot of the 6-in. curb was about $0.35.

Construction plans for 1958 indicate that a substantial amount of bituminous curb will be placed on our arterial street system.



● **SECTIONS through arterial and residential streets showing placement of curb. Machine must be on base, which must thus extend 4 ins. beyond back face of curb.**

What You Should Know About The MEMBRANE FILTER

EDMUND J. LAUBUSCH, M. S.

The author, a sanitary engineer, currently with The Chlorine Institute, Inc., participated in some fundamental studies on membrane filter technics as an officer of the U.S. Public Health Service. The statements made are based on personal experiences or otherwise are believed to have been drawn from reliable sources; they are not intended to reflect the position or opinion of either the author's present or former employers.

SELECTIVELY - PERMEABLE membranes have been used for almost a century in biological and clinical investigations. Their original use in 1933-34 for estimating bacterial concentration in water is credited to the Russians. During World War II, after laboratory facilities at Hamburg and Stuttgart had been destroyed, and owing to the scarcity of agar throughout Germany, membrane filters were employed in the conduct of routine water analyses, and they have been used there extensively ever since.[1]

Since 1947, when the Joint Intelligence Objective Agency (U. S. Dept. of Commerce) first studied the German facilities, methods of manufacture of membranes and filtration equipment and their utilization has been pioneered and developed in this country under the leadership of Dr. Alexander Goetz and his associates; the U. S. Army Chemical Corps Biological Laboratories at Fort Detrick, Maryland, with the cooperation of the now Millipore Filter Corporation; the Robert A. Taft Sanitary Engineering Center at Cincinnati; and others. Since that time, refinements in manufacture of membranes of uniform and consistent pore size, in filtration equipment, media and other essential appurtenances, and in application methodology, have steadily and rapidly progressed. Research is continuing chiefly along the lines of a continuing assessment of the reliability and consistency of membrane filter test results as compared to those of conventional technics, of further refinements in methodology and exploration of other uses.

Current Status of Development

An important factor which has inhibited more widespread utilization of membrane filters is the absence of a reproducible and true parameter as a baseline to which results can be compared. This is a shortcoming of all biological assay work. Moreover, in the case of quantitative coliform determinations, comparisons of necessity are sometimes dubious because of inherent shortcomings and incongruities of the conventional, multiple-dilution test itself, and of the most probable number (MPN) yardstick as a true index of sanitary quality. While the MPN expression of coliform density

● **TECHNICIAN placing a filter disc in the filter holder, which is mounted in a flask used in connection with a Millipore portable vacuum-pressure pump.**

often leaves much to be desired, the fact remains that no other more satisfactory and acceptable baseline has yet been devised. Correlation of membrane filter and MPN test results can be demonstrated only after proper consideration is given to reproducibility, bias and other limitations of an estimate of bacteria population.

One of the most important features of the filter technic is that it affords the opportunity to obtain a direct count as compared to a statistical approximation of a population. Strictly speaking, there is some question whether membrane filter and MPN coliform results are really comparable. By definition, coliforms, as ascertained by the MPN technic, include all aerobic and facultative anaerobic, Gram-negative, non spore-forming organisms capable of fermenting lactose with gas formation within 48 hours at 35°C. As ascertained by the filter technic, they include all organisms which produce a certain characteristic response—sheen formation —within 20±2 hours when nurtured with a standardized, differentiating nutrient.[2] Current indications are that, for all practical purposes, the two population groups can be considered alike in terms of differentiating selectivity; however, the sanitary significance of the difference, if any, remains to be determined.[3]

Further research has been indicated[4], particularly with reference to details of standardization of the test culture medium, time and temperature relationships for incubation, and on the efficacy of the technic applied to waters containing attenuated coliform organisms (e.g., pollution of remote origin).

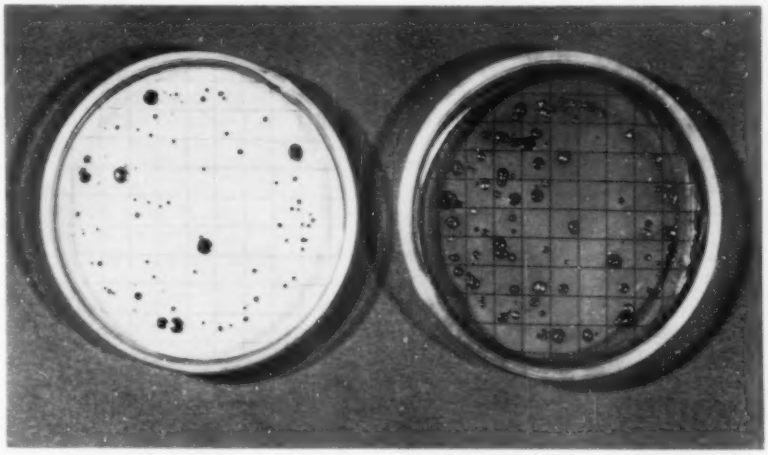
Current Acceptance

Based on several years of experience with the membrane filter technic by many laboratories, including routine comparative MPN evaluations, a standardized procedure having tentative status was incorporated in the 10th Edition of *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes*.[2] During the past year the appropriate Sub-Committee of Standard Methods has been considering approval of the membrane filters procedure, "or its demonstrated equivalent", as an acceptable alternate to the standard completed MPN test for the presence of coliform bacteria in potable waters. (Official endorsement of the technic is believed to be forthcoming in the near future.) However, it is recommended that parallel testing be employed at least until possible local limitations are defined and equivalent sanitary significance for routine sampling is demonstrated. This is epecially true for the examination of waters of unknown quality that show a high percentage of false positive presumptives in the standard dilution tube test for coliforms.

The National Research Council, having concluded that the advantages in using the membrane filter technic impressively outweigh the disadvantages, in April, 1956, recommended its acceptance for field bacteriological control of military water supplies. The report upon which this recommendation was based stated further that "The adoption of the membrane filter method as an alternative procedure for the (routine) measurement of coliform density would consitute a signal advance in sanitary engineering practices."[3] It is interesting to note that some of the scientists who were most conservative in advancing the use of the filter technic are now among the most enthusiastic promoters.

The Surgeon General of the U. S. Public Health Service, by notice published in the *Federal Register* on October 23, 1956 (21:206, 8110), and confirmed (22:11, 1271) on March 1, 1957, has amended Sec. 72.201-203 of the Interstate Quarantine Regulations to permit use of the membrane filters for the examination of potable waters aboard interstate carriers. For this purpose the minimum standard water sample is 50 ml (or a composite of this amount) and is filtered through one or more membranes, as necessary, to yield a membrane with no more than 400 colonies. Limiting coliform concentrations for compliance are essentially as follows:

1. The arithmetic mean density of coliforms for all samples examined in any month shall not exceed one per 100 ml; and,
2. Individual standard samples with a coliform density exceeding one/100 ml shall be allowed providing the coliform density does not exceed 3 per 50 ml, or 4 per 100 ml, or 7 per 200 ml, or 13 per 500 ml, or 22 per 1000 ml in:
   a Any two (2) consecutive standard samples;
   b More than 5 percent of all standard samples when 20 or more per month are examined;
   c One (1) standard sample when less than 20 per month are examined.



● **ENTEROCOCCI (left) and Coliform (right) determinations of water on Bac-T-Flex membranes. Note the 1/50th grid and the clear definition of the effective filter area.**

The limiting concentrations adopted are those recommended in the comprehensive report to the National Research Council by Thomas, Woodward, and Kabler[3] and are approximately quantitatively parallel to the original standards in terms of average conditions, and of the frequency and magnitude of random fluctuations above the mean level.

Amendment of the "Public Health Service Drinking Water Standards, 1946" to reflect this change is implied.

The Board of Directors of the American Water Works Association adopted a policy resolution on November 7, 1957, accepting the membrane filter technic as an alternate to the completed MPN test when the laboratory administrator concerned is satisfied that the filter test results are essentially equal to the completed MPN test results, and when the State approves application of the filter technic to public water supplies under its jurisdiction.

The Federal Civil Defense Administration has not yet adopted any official position regarding the stock piling of filter apparatus or membranes. For a long time, however, this agency has recognized the especial value of the filter technic for use in natural or wartime disaster activities, and recommends that civil defense health services consider its use and encourage their personnel to familiarize themselves with it. To a considerable degree, this position reflects that of the Chemical Corps' interests and investigations in CBR warfare control and of the U. S. Public Health Service to whom responsibility for public health and sanitation aspects of the FCDA program was delegated in 1954.

The Canadian National Health Department reputedly is using the MF as a standard for potable water with an allowable count of 2 coliforms per 100 ml. While the British have not yet officially adopted the membrane filter procedure for *B. coli* enumeration of water supplies, in accord with their practice, there is an increasing tendency to favor the method.[5] It is also being used extensively in France, Germany, Russia and other countries.[6]

While principal concern and effort in the sanitary engineering field has been focused on the utility of the filter technic for coliform determinations, with the ultimate objective of its appraisal as a standard method, many additional bacteriologic control uses also have been explored, some quite intensively. For example, its use for differentiating organisms of the coliform group,[7] and for determining specific pathogens as *Salmonella typhosa*,[8] *E. histolytica*,[9] *fecal streptococci*,[10] and others have been described.

In addition to its demonstrated applicability in the broad field of water quality control, it is expected that the utility of membrane filters will increase in other areas of interest to sanitary authorities—for dairy and food sanitation; air pollution and industrial hygiene control; radiological, microbiological and particulate assay of air and water, control of waste treatment processes, and for various other applications.

FILTER TECHNIC

The usual procedure for bacteriological assays of interest to sanitary authorities entails (a) aseptic filtration of the sample (concentration and deposition of organisms from the suspending fluid) onto or very near the surface of a sterile membrane; (b) inhibited or selective growth of the retained organisms; and (c) enumeration by direct observation. The pores of the membrane serve as capillaries, conveying a suitable liquid or semi-liquid nutrient upward through the membrane to the organisms, permitting growth and multiplication in situ. The sample filtrate, for all practical purposes, is essentially sterile, and thus complete isolation is assured when a membrane of proper porosity is employed.

The basic technic can be modified in several ways, or the membrane alone can be used as an adjunct to other qualitative or quantitative tests. For example, in some biological applications, morphological examination by transmitted light microscopy of stained microorganisms may be indicated; for studying the size-distribution pattern of particulate matter, direct microscopic inspection of the soiled membrane (transparent) may be all that is necessary; for certain quantitative determinations of interest to the sanitary chemist, spot color tests and conventional gravimetric procedures can be employed in conjunction with filtration through the membrane; for atmospheric monitoring of alpha- and beta-particle emitters, direct radiation counting can be employed.

The following sections deal principally with the membrane filter technic as it applies to bacteriological water examinations.

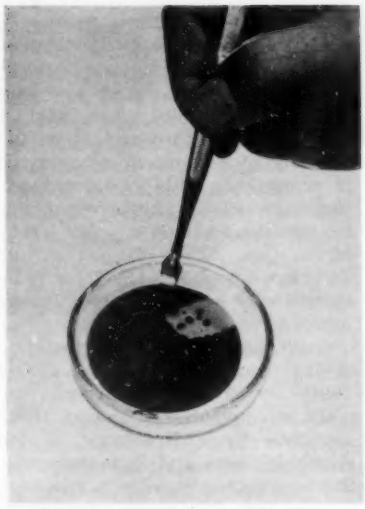
Filtration. Filtration (concentration) of samples is greatly facilitated when a differential pressure across the membrane is provided. The rate of filtration varies directly with the pressure up to the fracture point (above 70 cm Hg vacuum) and inversely with the amount and kind of particulate matter suspended in the vehicle. Laboratory filtration is best accomplished under vacuum, with an electric vacuum pump or a water-actuated aspirator to produce the necessary pressure reduction in the filtrate collection container. In the field, portable hand pumps, rubber aspirator bulbs, or syringes are satisfactory.

Culture Media. The selection of the proper culture media, or the adaptation of conventional media to membrane filter analyses, is perhaps the most critical part of the technic. For determination of coliforms, and type differentiation from other bacterial flora which are common inhabitants of potable and waste waters, numerous selective media and test modifications have been proposed. Some involve a two-step procedure: preliminary incubation of the inoculated membrane on an enrichment broth medium for about two hours, followed by the physical transfer of the same membrane to a selective nutrient medium for the balance of the incubation period, about 18-20 hours. Others eliminate the preliminary enrichment step entirely.

The reader is referred to Standard Methods for discussion of media currently acceptable for coliform determinations. Data available suggest that EHC-Endo (now called SEC-Endo) or BGF broth can be used interchangeably for many water samples. The BGF broth is reported to be more effective in suppressing growth of non-coliforms, and is especially suitable for those waters where the non-coliform to coliform ratio is high and where colony crowding and interference with sheen production may result. Slanetz and Bartley[6] do not support this generalization. Other differential media can be used if demonstrated to be equivalent or superior to the EHC-Endo or BGF broth in terms of ease and reproducibility of preparation, productivity of differentiated coliform colonies, validity of colony differentiation, ease of colony identification and inhibition of non-coliforms.

The two-step culturing procedure stipulated by Standard Methods is somewhat cumbersome. Efforts have been made to develop a simpler procedure that eliminates the intermediate transfer step without sacrificing sheen formation or coliform recovery. Hajna and Damon[16] reported a single-step procedure utilizing a modified desoxycholate lactose broth (H-D). Slanetz and Bartley[6] also support a single-step procedure, claiming greater inhibition of non-coliforms, greater coliform recovery, and less colony confluency.

Particularly adaptable to field culturing is a dehydrated scheduled nutrient (DSN) developed by Goetz et. al.[17] which is purported to permit identification or differentiation of coliforms without the necessity of transfer procedures. This schedule, consisting of two dehydrated pads—one impregnated with an enrichment nutrient, and the other with an inhibitory, differentiating medium—is sold under the trade



● **REHYDRATION of AG Chemical Co. dehydrated scheduled nutrient (DSN).**

name Isopor DSN by the A. G. Chemical Company. DSN's in units of two or six are sterile-packed with sterile MF (HA) membranes in polyethylene envelopes.

The Millipore Filter Corporation markets a single-step MF Endo Medium which is an extension of the single-step Hajna-Damon broth. This medium is supplied by the company in ampul form for use with the MF Field Monitoring Kit, and also is available in dehydrated form from all major media suppliers. Comparative tests recently reported[28] indicate a superior coliform recovery and selectivity (colony differentiation) as compared to the H-D single-step Endo medium.

If it is desired to defer incubation of inoculated membranes, a holding medium is available which effectively preserves the viability of coliform organisms for as long as 72 hours and minimizes growth.[18] Thus, considerable latitude is provided for time elapsed in shipment without serious detriment to the validity of the sample evaluation. Upon receipt of the culture assembly at the laboratory, the inoculated membrane is transferred to an appropriate coliform differentiating medium in accord with current recommended practice.

Salem-Brosius, Inc., has developed a new, two-step coliform culturing technic known as the "TET" or Terminal Endo Technique. Following membrane filtration of the water sample, a primary medium is employed for the production of undifferentiated colonies in 14-16 hours at 37° C. Subsequently, the membranes (bearing the undifferentiated colonies) are transferred to the terminal indicator medium which differentiates coliforms and noncoliforms in 1 to 2 hours at 37° C. The technic is claimed to yield a more rapid and higher recovery of concisely differentiated coliform colonies. It is understood that this patented medium soon will be marketed in dehydrated form, and that two-step, impregnated culture pads soon will be substituted for the single-step dehydrated modified Endo pads currently made by Salem-Brosius, Inc. and used in the Sabro Portable Laboratory.

Though extensive and independent comparative tests are reported by the manufacturers, the results of these investigations have not yet been published.

Incubation. Taylor, et. al.[5] recommend 37°C incubation for one hour on a resuscitation broth, followed by an additional 17-hour incubation at 37°C on a modified MacConkey broth for coliform determinations. In comparing this procedure with that specified by Standard Methods employing a modified Endo broth, they observed both a higher coliform recovery and greater coliform selectivity. Slanetz and Bartley[6] were unable to confirm this observation.

It is apparent that considerably more investigative activity pertaining to optimum culturing conditions is indicated. However, membrane filter culture technics as defined by Standard Methods, or their demonstrated equivalent, are sufficiently precise to warrant immediate application to most coliform tests of water quality.

Optimum incubation temperatures do not appear to be different from those specified for conventional procedures, but incubation periods are many times shorter.[1-7] At least one group,[11] however, suggests that incubation at 32°C may yield more coliforms than are obtained at the standard temperature, 35°C.

There remains some question as to the importance of moisture control during incubation, and its effect on coliform colony recovery. Some early investigators [1, 12] recommend that inoculated membranes in suitable containers be incubated in an inverted position on a saturated towel or filter paper, either in a conventional hot-air incubator or in a thermostatically controlled water bath; and, in the case of field incubation, submerged within a leakproof container in a vacuum thermos bottle.[17] Some later investigators [6, 13] suggest that it is not essential that incubation take place in a water-saturated environment; Eye et. al. [11] report that no significant difference in coliform recovery or sheen development is evident above 35 percent saturation, but that below this level complete dehydration of the membrane culture assembly occurs. In any case, it is essential that there at least be sufficient moisture during incubation to preclude evaporation of the liquid nutrient. Standard Methods provides for incubation in an inverted position with constant saturated relative humidity at 35° ± 0.5°C.

Suitable incubation conditions are ideally obtainable in the laboratory with a thermostatically-controlled water bath. If simple precautions are taken, conventional hot air incubators can be used. For example, sealed culture containers may be used[13-15] or the desired level of humidity can be obtained by subjecting a given surface area of water to evaporation with convection air circulation within a sealed incubator.[11] In the field, because of the type of culture containers usually employed, portable hot air incubators are satisfactory. Alternately, immersion in a hot water vacuum bottle (as described later) can be used. Under certain emergency conditions an unconventional technic of incubation by body heat is satisfactory where culturing is optimum between 33° and 37°C.[13]

EQUIPMENT AVAILABLE

Culture Containers. Many types of flat-bottom containers can be employed and there is no rigorous standard in the United States at present. Sterile glass containers of the petri dish type appear preferable for routine laboratory use and are so recognized by Standard Methods. Their use, however, normally requires some means of maintaining a high humidity level during incubation. In England single-use ointment tins are now used almost exclusively.[5]

For field application non-breakable containers are preferable to glass. Disposable plastic containers are satisfactory and are commercially available with a sterile membrane included from the Millipore Filter Corporation. Furthermore, they can be re-used if desired, subject to being restored to a sterile condition, although this may be difficult since

● MEMBRANE filter sampling apparatus: Isopor membrane holder, Model B, exploded view of filtration portion.

● SAMPLING apparatus for filter: Salem-Brosius Sabro filter assembly.

they will not withstand either hot-air sterilization or autoclaving. Where chemical disinfectants are employed such as formaldehyde, chlorine solutions, ethylene oxide, etc., it is essential that no toxic residual remain. Inexpensive single-use lacquered-metal ointment tins of an appropriate size, commercially available from most pharmaceutical and laboratory supply houses, also have proven satisfactory and, moreover, can be readily sterilized by conventional means or pre-sterilized at the source.[13] Salem-Brosius, Inc., markets this type of pre-sterilized container with a sterile membrane and dehydrated nutrient pad for coliform or total count assays.

Plastic and metal containers are sufficiently tight to prevent excessive nutrient evaporation and, properly employed, there is sufficient adhesion between the nutrient pad and container surface to withstand rough handling without wedge devices to prevent slippage of the membrane culture assembly. However, neither type is water-tight and must be sealed or otherwise protected if submerged incubation is used, although this does not appear significant for more conventional incubation.

In selecting culture containers for either laboratory or field use, freedom from suppressive characteristics on colony development due to the material composition of the container, if other than glass, must be demonstrated.

Membranes. Filter membranes suitable for use in water quality control tests are available from the Millipore Filter Corporation, marketing under the trade name MF, and the Carl Schleicher & Schuell Company, marketing the German-made "Coli-5" membrane under the trade name Bac-T-Flex. Some other companies involved in membrane filter equipment sales also function as market distributors. For other than routine purposes, the membrane supplier should be consulted on the type of membrane best suited to the particular objective.

The MF membrane is most commonly used in the United States for bacteriological water examinations, and its utility has been so recognized by Standard Methods although other "equivalent" membranes also may be used. These membranes have a porosity of about 80 to 85 percent, and are stable in either a wet or dry state. The capillary pores, about 50 million per square centimeter, are reported to be unusually uniform in size and shape. Hydrosol-type MF's (AA) are used for surface retention within 2μ depth of waterborne pathogens, coliforms, and other enteric bacteria; aerosol-type MF's (AA) are used for microbiology of gases, particle sizing, tissue culture, and other purposes. About a dozen other types of membranes, with pore sizes ranging from 10μ to 5μ are available for specialized uses, e.g. MF (DA) for coliform determinations in milk and cream, and MF (RA) for radio assays and certain microchemical analyses.

Grid-marked MF's—to facilitate colony enumeration—are available (with an absorbent nutrient filter pad) in convenient packages (pre-sterilized by high-voltage, if desired) for field and laboratory use. Sterile, polystyrene-ring mounted membranes for special purposes, such as for field sampling of hydrosols or aerosols, are available, as are similarly-mounted membranes for use with the Millipore MF Field Monitoring Kit. MF membranes packaged with dehydrated nutrient pads are distributed by A. G. Chemical, Salem-Brosius, and Skyway Chemical for use with field testing kits.

● FILTER holder by MF for bacteriological analyses of water and sewage.

The Bac-T-Flex membrane differs from its European prototype in that toxic materials have been removed, it is grid marked to facilitate colony enumeration and it can be sterilized in the same manner as the American MF membrane. Bac-T-Flex membranes are currently packaged only in boxes containing 100 each and, unlike the MF, are available neither in sterile conditions nor with a dehydrated, nutrient-impregnated filter pad.

Dyed membranes are available for examinations where high visual contrast is essential. Such membranes present a non-fluorescing field under ultraviolet light, and are especially useful to oceanographers, for example, in concentrating and detecting fluorescent particles.[20]

Since membranes are soluble in methanol, esters, ether - alcohols, and ketones, when in solution with the retained materials they can be used in electron microscopy or spectroscopy. This provides an especially useful means for recovering and analyzing particulates; or, for example, in the estimation of plankton pigments.[21]

Membranes have a uniform index of refraction (1.49 to 1.51) and can be rendered almost completely transparent by filling the pores with a clear liquid, such as immersion oil, having the same refractive index. Thus, deposited surface material can be inspected microscopically using an immersion objective and high optical resolving power for particle-size-distribution studies in the collecting medium, for indentification and counting of algae, etc.[22]

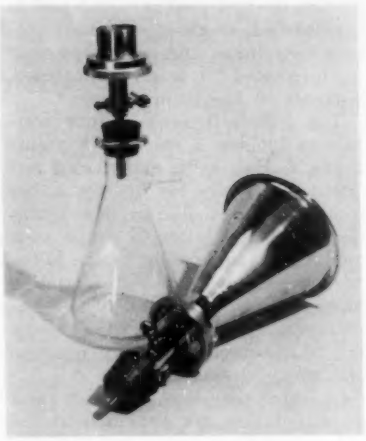
Because of the high dielectric constant and surface resistivity, substantial electrostatic charges are developed by friction resulting from filtration of aerosols. Thus, absolute retention of traceable particulates from a dry gas filtered through a membrane can be achieved. For example, exhaustive electronmicroscopy studies are reported to show 100 percent retention of particles greater than 0.005μ with the MF (AA) filter having an average pore size of 0.8μ.[23,24]

For determination of membrane-retained suspended solids routine gravimetric procedures are especially suitable as it is claimed by one manufacturer that the membrane ash is zero (to four significant figures, grams per sq. cm.).[27]

Membranes can be sterilized by (a) autoclaving (preferred); (b) ultraviolet radiation or high voltage; or (c) by exposure to ethylene oxide vapor or other chemical means. They cannot be sterilized by dry heat nor is boiling recommended since this tends to make them brittle.

Filter Apparatus. The basic elements of the hydrosol filter apparatus are (a) a funneling device to receive the sample; (b) a porous support for the membrane; and (c) a filtrate collection chamber.

Metal units for routine laboratory use should be simple in design, easily cleanable, durable after repeated (heat) sterilization exposure and of adequate capacity. Commercially available units for laboratory use are of 30-ml to 500-ml and 1000-ml capacity; the latter are preferable for routine sampling of highly purified waters.



● **COLI-5 filter sampling apparatus by Carl Scheicher and Schuell Company.**

As will be noted from the illustrations of currently manufactured filter devices, there are some variations in the design and appearance of the sample-receiving device. Generally the units are available in a seamless, corrosion-resistant alloy metal having a highly-polished finish, or in pyrex glass. The shape of the unit appears to be chiefly a matter of individual preference rather than one of relative convenience, cleanability, etc., although some observers report in favor of conical units as affording better drainability.[5,6] The 30-ml funnel device peculiar to the all metal S & S Coli-5 unit (also interchangeable with a 500-ml section) is especially suitable for investigations requiring only small sample volumes. This unit has found wide acceptance abroad and has been adopted by the British for routine use.

Pyrex units, of course, require more careful handling and are less suitable for field use. While considerably less expensive than the metal variety and constructed as to provide an adequate seal to insure against sample leakage, some workers have reported that they are cumbersome for routine laboratory use, particularly if the sample load is heavy.

The membrane support should be smooth and porous, and should permit uniform liquid flow into the collection chamber under normal negative or positive operating pressure. Porous carbon, sintered glass or steel disks generally are used. All appear equally satisfactory.

The means of insuring a bacteria-tight seal across the porous membrane seat between the funnel and receiver, without damaging the delicate membrane, is critical. For graduated Millipore pyrex units, a simple spring-type clamp which engages the lips of the funnel and the base is used. In the S & S Coli-5, Millipore MF, Skyway Universal and A. G. Chemical Isopor units the funnel and lower part of the apparatus are closed by a bayonet locking joint assembly of slightly different design in each case. All are believed satisfactory for the purpose.

The filtrate collection chamber need be nothing more complex than a glass side-arm vacuum flask. All commercial apparatus are designed for vacuum filtration of samples. The Coli-5 unit has a stopcock through which filtration of the liquid through the membrane can be easily controlled. The Sabro assembly, similarly equipped, is constructed of stainless steel and is shaped to accommodate the other elements of the filter apparatus for storage or transit.

Sterilization of the vital surfaces of the filter units described can be achieved most conveniently with hot air or by autoclaving. Especially valuable for between-sample sterilization under field conditions, if necessary, is the use of formaldehyde produced by incomplete combustion of methanol. Except for the Coli-5 and Sabro units, a sterilization base with other necessary appurtenances (optional equipment) is available from the manufacturers for this purpose. In the field, immersion in boiling water for about one minute or the use of an alcohol flame on vital surfaces is satisfactory. Experience suggests that sterilization of the filter apparatus may not be necessary although it is recommended that this be done at least at the start of each day's testing.

FIELD SAMPLING

A unique feature of the membrane filter technic is that it is easily adapted to field use. Analyses can either be partial or complete. The sample might only be filtered in the field, the inoculated membrane being carried or mailed to a laboratory (on a suitable differentiating medium or, if a long delay is anticipated, on a preservative medium, at ambient temperatures) for culturing and evaluation; or,

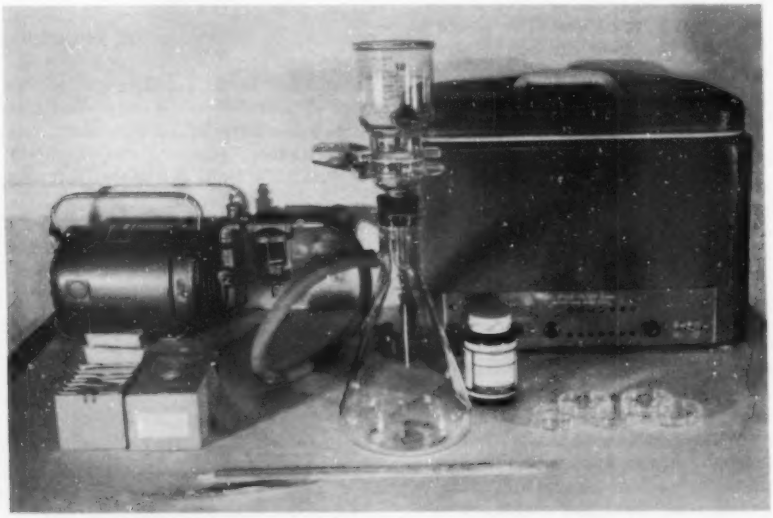
complete analysis and evaluation might take place at a site remote from a laboratory. The technic of partial field application reportedly yields results comparable to the MPN test on refrigerated samples examined after 24 hours holding, and superior to those obtained from unrefrigerated, stored samples.[18] The logistic value of field testing is apparent, especially for emergency use. Furthermore, recourse to either partial or complete field testing obviates the necessity and very considerable expense of in-transit refrigeration of bulky water samples, and minimizes inconsistencies, uncertainties, and inaccuracies inherent in this procedure.

Portable laboratory facilities for field testing can be improvised. Several varieties also are available commercially; all are designed to provide testing facilities in any situation where expedited water quality tests are needed and standard laboratory facilities are not conveniently available. Such uses as aboard ship, in civil defense and disaster work and in underdeveloped and rural areas have been suggested.

Portable Laboratories. Salem-Brosius, Inc., markets a 1.1-cu. ft., 25-lb. Sabro Portable Laboratory designed for either full-field or partial-field and laboratory use. Fisher Scientific Company is the exclusive laboratory supply house distributor of this unit. All necessary equipment for 18 coliform and/or total count determinations is included. The sample is drawn through a Sabro Filter Assembly by syringe-induced vacuum into the 500-ml stainless steel receiving flask. Inoculated membranes are placed on a sterile, de-hydrated nutrient pad in pre-labeled, single-use (metal) culture containers, and are stored and/or incubated in a self-contained, magnetized incubator drawer.

The Salem-Brosius culture containers include a sterile MF membrane and a sterile, dehydrated nutrient pad ready for use for either total count or coliform determinations. For the latter, a single-step, modified Endo (similar to the Millipore modified Endo differentiating broth) currently is used. (The manufacturer expects to replace this by the newly-developed TET medium previously discussed.)

Constant-temperature heat and air circulation are provided in the Sabro unit by a motor and a squirrel-cage blower operating with 115-volt, 60-cycle ac power, 105 watts. Converters are available for operation from 6-volt auto batteries and other d-c power sources. The unit is pre-calibrated to 35°C and tested for 24 hours prior to shipment. Because the thermoswitch might be disturbed in transit, the manufacturer recommends that the unit be re-calibrated before it is placed in service. The temperature range of the thermoswitch is from —100°F to 400°F, and ±1°F tolerance is guaranteed within 95° to 113°F (35°-45°C). The thermoswitch is calibrated to activate the heating motor to turn on at 97°F and off at 99°F, although it can easily be calibrated to turn on at 111°F and off at 113°F. At 70°F the warm-up period to maintain temperatures of 30° and 45°C is approximately 30 minutes. A 125°F Weston Dial thermometer is included with the unit for control observations.



● **FIELD kit by Millipore. Vacuum pump at left, filter in front, incubator right.**

The A-G Chemical Co. manufactures the Isopor Water Laboratory, a 1.55-cu. ft., 26-lb. unit. It contains facilities for 24 samples employing Isopor Dehydrated Scheduled Nutrients for quantitative coliform detection. Other principal components of this unit include a permanently-mounted base for formaldehyde sterilization of the Isopor funnel assembly between successive samples; a hand-operated, vacuum pump for drawing the sample at about 12-in. Hg through the membrane into a one-liter aspirator bottle which can be drained in place; and submerged incubation of plastic-sealed, glass culture containers. Culture containers and spring-free dispensers must be pre-sterilized before taking the unit into the field.

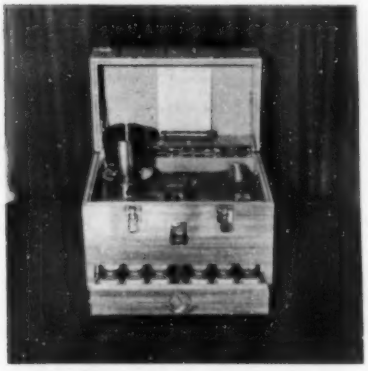
The Isopor unit functions independent of any source of electric power. Its operation is predicated on provision of a hot-water environment of sufficient temperature to facilitate bacteriological growth. The vacuum bottles used are reported by the manufacturer to be capable of maintaining the water temperature within approximately 12° of the filling temperature for 16 hours at room temperature of 20°-22°C. This means that colonies are exposed to the usual incubating temperature, 35°-37°C, only for a few hours during the initial growth phases. Based on reports by Goetz et. al.,[17] the manufacturer claims that a sliding - scale incubation scheme is satisfactory for coliform growth; moreover, it is claimed that pre-heating the vacuum bottle and its contents to 39°-40°C serves to minimize coliform confluency on densely-populated membranes and suppresses heat-sensitive organisms other than coliforms. Eye et. al.[11] report that a temperature drop-rate of less than 1°F/hour in vacuum-bottle incubators yields a coliform recovery equal to or better than that obtained under standard laboratory conditions. (With a drop rate in excess of 2°F/hour, sheen development by coliform was poor for the standard two-step EHC-Endo and the Hajna and Damon one-step broth; the effect was less pronounced for single-step Endo and DSN, in that order).

The importance of moisture during incubation has been discussed elsewhere. It is the author's opinion that sufficient moisture is provided for rapid colony development in tight-fitting plastic or metal culture containers or in glass containers wrapped with adhesive plastic film.

Skyway Chemical Corporation of Los Angeles markets two, 2-cu. ft.,

33-lb. portable laboratories similar to the Isopor unit. The smaller of the two units is completely equipped for 12 bacteriological tests while the larger one is equipped for 24 tests in the laboratory or in the field. MF filters and DSN nutrient are employed, with culturing accomplished in either glass or plastic containers.

The manufacturer reports that the laboratory recently was improved by the optional replacement of vacuum incubation bottles with a stainless steel, double walled, insulated incubator to hold 30 culture containers. The incubator, electrically controlled with a fenwall thermostat can be used either in the laboratory or in the field, and comes equipped with either a 6-volt or 12-volt transformer.



● **SABRO portable laboratory for field work made by Salem-Brosius Company.**

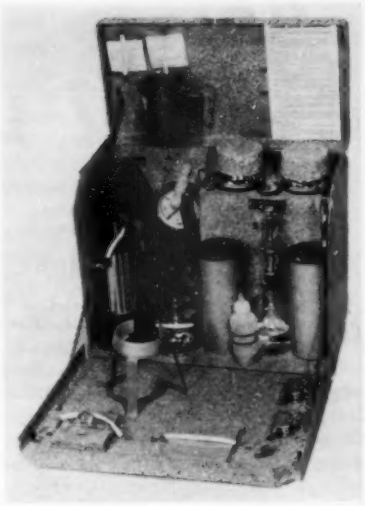
In addition to the two units mentioned, Skyway also markets two Micro-biological Conversion Laboratories, with the new incubator as optional equipment. The laboratories are equipped with two, 500-ml Skyway Universal filtration units with field sterilization accessories and all other necessary equipment for 24 tests. The larger unit also contains conversion equipment for laboratory and field aerosol analyses.

Monitoring Kits. The MH Field Monitoring Kit manufactured by the Millipore Filter Corporation is not a portable laboratory in the same sense as are the units discussed above. Basically, the kit consists of a cardboard mailing container which includes essential components for either one or two samples: A disposable "Monitor," sampling tube, and ampul-contained, control-tested bacteriological medium sterilized and ready for use. A separate kit, consisting of a syringe, valve and sampling cup also is required for field use.

The monitor consists of a grid-marked, 37-mm MF (HA or AA) membrane fixed within a resealable, disposable plastic unit which serves as a combination filter holder and culturing dish, and through which the sample is drawn. The monitor is sold in packages of 100. The ring-mounted membrane, which rests on a mesh-supported absorbent pad, provides the same effective filter areas as the standard 47-mm membrane. After the membrane has been inoculated, the unit is turned over and the contents of the appropriate nutrient ampul are syringed through the membrane onto the absorbent pad. The design of the kit units is such that erroneous manipulations are prevented. The monitor is resealed and ready for shipment or in-place incubation.

Five-inch sterile sampling tubes sealed in polyethylene envelopes are available in packages of 100. Various types of media are available in ampul form depending on the test objective. For delayed incubation, a holding medium, after the method of Geldreich, et. al.,[18] is available. The unit is designed to omit preliminary enrichment prior to differentiation with MF Endo medium.

If field incubation is desired, a 13 1/2-lb. field incubator, accommodating 170 monitors, is available. The design is such that incubation of cultures other than the monitors can be accomplished. The incubator operates on 6- or 12-volt dc or 110 or 220-volt ac current, and has a thermoswitch guaranteed by the manufacturer to hold within ±1°C of the set temperature in the range of 27° - 44°C. It also is equipped with an indicator light, safety fuse, thermometer, and two cords for use on either a standard outlet plug or a cigar lighter plug. A sealed thermometer is mounted on the inside cover.



● **ISOPOR water laboratory kit for field sampling made by A. G. Chemical.**

The U.S. Naval Preventive Medicine Unit at Norfolk, Virginia, has used the Millipore field incubator for incubation of MH Field Monitor Kits and has observed that the unit is capable of maintaining a temperature of 35°C or 37°C ±3° at room temperature. No provision is made to prevent air stratification although the author is not aware that this has been reported to be objectionable.

For coliform determinations performed in accord with Standard Methods, the results using media preparations peculiar to the Sabro (TET), Isopor (DSN) and MH (MF-Endo) units must be demonstrated to be equivalent to those obtained if the standard, two-step culturing procedure were employed.

APPLICABILITY OF FILTER TECHNIC

In water analysis, Thomas et. al.[3,4] has demonstrated that the results of membrane filter tests are from two to five times more precise than those obtained from a 5-5-5-tube MPN performed under comparable test conditions. In water quality control this means that more information is obtained from each sample collected, a gain which may be realized either in the form of a reduction in the number of samples analyzed, or in improved knowledge of bacterial concentration and variations.

Coliform density estimates by the filter technic generally are somewhat less than those obtained by the MPN method. This is due in part to the mathematical bias of MPN estimates (always on the high side). Also, in some water where the ratio of non-coliform organisms to coliforms is high, difficulties in coliform differentiation may result. Discrepancies also may be attributable to other peculiarities of the water examined or to an inhibitory action of the bacteriological growth medium itself.

Waters high in algae, organic silts and other suspended matter may contribute to filter clogging,

(*Continued on page* 162)

BRIGHT LIGHTS for ATLANTA

GUY BROWNING ARTHUR

ATLANTA is said to be the best lighted city. Peachtree Street is a brilliant "White Way" 15 miles long, the longest in the South. Thirty-three miles of expressway weave through and around the city and shaded residential streets are safe for cars and pedestrians. But Atlanta's lighting was not always good. Mayor William B. Hartsfield recalls that in the late 1920's poles were placed to please favorites. "We stuck them out in front of people's houses without any good reason. We let the downtown streets go." No differentiation was made between lighting on traffic arteries and on residential streets.

Joe B. Browder, Division Lighting Engineer of the Georgia Power Company, and a member of the Street and Highway Committee of the Illuminating Engineering Society, proposed that the system should be rebuilt on an over-all plan, according to recommended standards of the IES. This idea was accepted, and it was agreed that main arteries should receive first consideration. Accordingly, late in 1946 the city council passed a resolution to relight 19 selected thoroughfares on IES specifications. It is believed this is the first time the organization and its recommendations were mentioned in council legislation in any city.

So the first five-year plan began and to many people it may have seemed unnecessary. There are always some who think they are getting along well enough. There were 300-watt post-top incandescent globes on highly ornamental standards. The units were eminently successful in wasting light into the sky, shedding little on the streets, and throwing out the maximum of glare. Shadows were accepted as inescapable. One shop window would be dark, and another threw back dazzling reflections. As in many another advance we may wonder how we tolerated pre-war lighting.

Actively supported by the mayor and a small group headed by Alderman John A. White and Dewey L. Johnson, the new plan was started.

● DAYTIME view of Cleveland Avenue exit from Highway 41. All poles are of steel, octaflutes; the luminaires are 30 ft. above the pavement on 15-ft. brackets.

Through it 23 miles of thoroughfares were lighted by 1,391 new fixtures, IES Type III refractors, rated at 10,000 lumens. They were mounted on upsweep brackets 26 feet above the pavement. The spacing of standards was approximately 100 feet on centers, staggered on opposite sides of the street.

For streets heavily shaded by a canopy of tree tops, the engineers devised a method of stringing the fixtures on cables above the center of the street. For this part of the installation, on important thoroughfares, the illumination on the pavement measured about 0.9 foot-candle.

Residential areas were not neglected. Toward the end of 1946, Mr. Browder recommended to Alderman White that 4,000 of the 5,800 obsolete 2,500-lumen fixtures on residential streets be replaced with 6,000 lumen IES Type I refractors. This program was to be executed over a five-year period, changing 800 luminaires each year. Installation was to be on two separate plans. On semi-thoroughfares 1,139 of the 4,000 new lights were to be on 200-foot centers, replacing 283 of the old 2,500-lumen fixtures. On strictly residential streets the new lights were to be placed as indicated by local conditions, such as intersections. This plan for residential areas was adopted by the city council early in 1947, to run through five years to 1952.

There was considerable delay at the beginning of this period because of shortages in labor and materials, but the plan was completed on schedule. Through the period, the city had the Power Company add about 700 more lights, all on the same specifications.

The downtown white way system is owned, operated and maintained by the city. Here, before the second World War, were the 300-watt, post-top, incandescent globes mounted on ornamental standards. They were replaced by modern 16,000-lumen mercury vapor luminaires in the congested business section. In other parts of the white way 10,000-lumen incandescent units were installed. These are IES Type VI refractors, on upsweep brackets.

Five-Year Plan Completed

Completion of this first five-year plan was a triumph for engineered planning, expressed in research, painstaking surveys of the needs of the city with respect to use and concentration, and selection of the best units for different kinds of service. As Mayor Hartsfield said it, "new lights ought to be put on . . . streets according to the advice of

competent engineers, and city officials ought not to be the ones to say where they should go."

When the first five-year lighting plan was finished the city covered 55 square miles. Early in 1952 it annexed 82 square miles, bringing the total to 137. This sparked the second five-year plan. Expressways were being built, with a new demand for lighting. These were included in the plan which was then set up.

● **NIGHT view of the same Cleveland Avenue exit shown on the opposite page. Note that ramps for exit and entrance are clearly visible, even in this reproduction.**

A survey was made of the new areas taken into the city, disclosing that they were lighted with 1,795 units. During 1952 the city council authorized 1,500 new lights for annexed areas; in 1953 a total of 1,370 was added; and in 1954 it was determined to add about 436 each year until the whole area had been covered.

As a standard specification the old ornamental standards were replaced by tapered steel poles with upsweep brackets, spaced in a staggered plan about 95 feet apart. The light on the pavement is about 1.8 foot-candles, or 50 percent above the minimum standard.

For lighting residential streets, luminaires which throw light on the pavement were selected, shielding homes, with refractors which beam the light up and down the streets. At intersections three and four-way distribution holds the light down on the pavement.

Expressways pushed more and more into the forefront of the program during this second five-year period. Improvement of street lighting had now made such progress everywhere that adequate lighting was accepted as indispensable for all throughways. More than 33 miles of expressways are now in use in Atlanta. Most of the units on them are rated at 20,000 lumens, and the others have a type of fixture that can be converted to this rating. All are mercury vapor.

More lights have been added steadily in the annexed areas. On University Avenue 74 mercury vapor luminaires of 20,000 rating, and 72 of 11,000, have been installed. In addition, 5 units of 20,000 lumens, and 10 of 11,000, have been installed at intersections. About 300 incandescent units have been added in parks.

General Electric luminaires are used throughout. On the expressway they are 20,000 lumens, standard mercury vapor. On the streets, in the system owned and operated by the city, they are 15,000 lumen, vertically mounted. There is one section four blocks long in the downtown section where 20,000 lumen fluorescent units have been installed. In the outer sections, where the system is owned and operated by Georgia Power, there are about 16,000 incandescent lamps on wooden poles, and the intensity of lighting varies considerably.

The poles used throughout the two five-year periods are distinctive. All are tapered steel, supplied by The Union Metal Manufacturing Company, and all are octaflutes—8 flutes, except for those on the South Leg of the expressway, which have a round cross section.

More than 1500 of these poles have been erected on the 33 miles of expressway. Those on the roadway have transformer bases, with either 12-foot or 15-foot brackets, and are spaced about 125 feet apart. The luminaires are 30 feet above the pavement. On access ramps the poles are the same, but the spacing varies with the design of the ramps.

Financing

When the first five-year plan was adopted by the city, the overhead system was owned and operated by the Georgia Power Company, and, as in many other cities, this Power Company not only initiated the new plan but took the lead in financing it.

As one example, when it first proposed the modernizing of lighting in residential areas, it offered to contribute $16,000 per year if the city would match this with $15,200, or $19 per fixture for 800 units to be installed each year, over five years.

● **THIS IS a typical expressway underpass with ramps to the cross street. Exit is to Peachtree Street. Complete lighting facilities aid in safe traffic movement.**

● **CLOSE-UP of the Cleveland Avenue exit of one of Atlanta's expressways. More than two dozen luminaires are visible from this point, an indication of the extensive lighting system installed to make night-time driving as safe and pleasant as during the day. Note also the fence in the center mall, typical of the thousands of miles of fencing that will be installed in our growing network of four-lane expressways.**

During the first five years, in which 4,678 of the 250-candle-power lights were replaced by 600-candle-power units, the cost of conversion was over $350,000, or about $75 per unit. Of this the Power Company paid $262,000, or about $56 per unit, and the city paid $88,800 or $19 per unit.

As of November 1954 the Georgia Power Company had spent a total of $1,977,381 on the entire lighting system, and the city had paid out only $388,564, in a ratio of $5 for the Power Company to $1 for the city. No later figures are available, but they would run in the same ratio.

Benefits

Detailed records of night crimes and accidents were not kept in the police department before the beginning of the first five-year plan, and it is difficult to pin recent figures down to percentage gains. However, one table that has been published covering a period from 1942 to 1953, shows a decrease from 50 percent to 34 percent in all accidents after dark; and a decrease from 58 percent to 48 percent in the number of fatal accidents after dark.

Police Chief Herbert Jenkins says that crime in the newly lighted areas had decreased about 50 percent as of the spring of 1955. This is a significant improvement—far greater than figures may indicate—because most of the serious crimes are committed during the night.

The National Safety Council reported that the number of traffic fatalities declined 54 percent during the first nine months of 1950, but this figure is not broken down into day and night accidents, so it does not help in evaluating the lighting in the deterrence of crime or accidents.

Even if figures in Atlanta are sketchy they are not discouraging, for statistics for many other places prove beyond doubt that adequate lighting does reduce the number of accidents and the incidence of crime after dark. These figures apply to Atlanta with particular force because the new system is far above the average in efficiency and coverage for cities of its size.

Such figures may be emphasized too strongly in measuring the value of a street lighting system. The morale of the public is lifted when streets become safe for driving and walking. The value of shop windows rises to higher levels when pedestrians and drivers are attracted to them by better lighting. Better street lighting often starts a wave of renovating and improving store fronts. Light moves people into more seemly behavior on the street, just as darkness is used to cover nefarious activities.

With all our striving to get the best of everything, we like to hark back to things as they were before we became so modernly efficient. We like to remember some aspects of the long ago. So Atlanta still maintains one of its old gas street lights at the corner of Whitehall and Alabama Streets, keeping it burning day and night. Perhaps it should make us wonder how far we have actually come on the road to perfection. A 20,000-lumen mercury vapor light on a steel pole may look just as queer to the people of Atlanta fifty years from now.

CALUMET SKYWAY SIGNS DESIGNED TO MAKE NEW TOLL ROAD ONE OF NATION'S SAFEST

More than 300 specially designed reflector and neon illuminated highway signs being made for Chicago's new eight-mile Calumet Skyway have been engineered to help make the overhead toll road the safest and most clearly marked link in the non-stop Chicago to New York turnpike system.

To warn motorists before they reach the toll station at 87th street, special yellow neon signs have been constructed which continually flash CAUTION and advise drivers to reduce speed. Brightly illuminated red neon signs, encased in unbreakable plastic and stainless steel, indicate passenger and truck toll lanes, and also several time-saving lanes attended by automatic coin machines. Several of the signs can be switched to read either "attended" or "automatic" lane, to enable toll road authorities to adjust traffic patterns at the pay station.

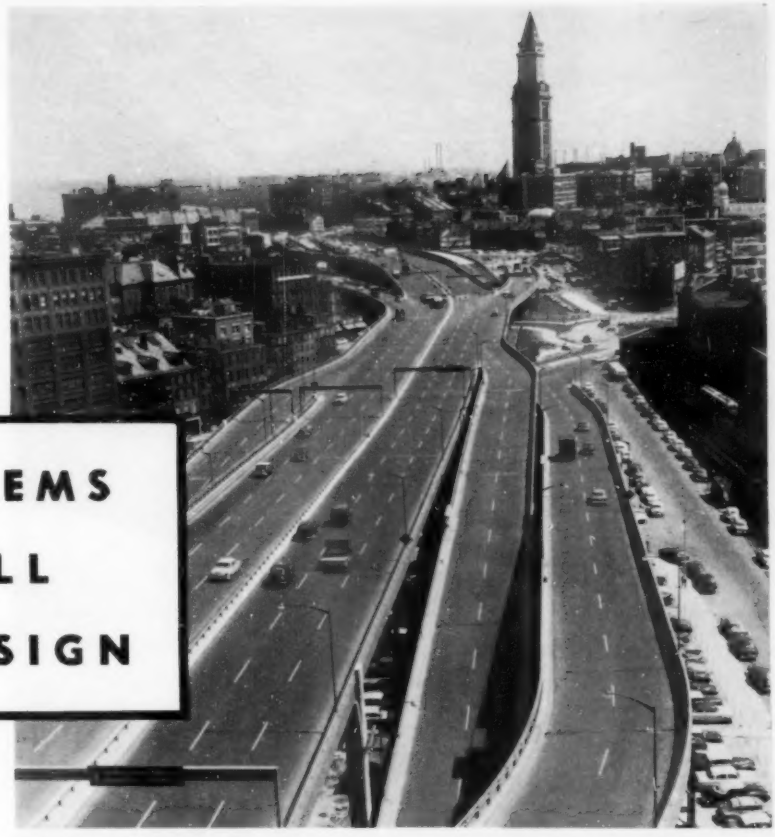
Dark blue and white highway direction signs at all exits and entrances, made of interlocking aluminum extrusions for durability and strength, employ silver reflective sheeting on all letters, numerals and borders. In addition, 200 distinctive trailblazer signs will be posted on all streets and roads leading to the Skyway's entrances.

The special signs were made by Federal Sign and Signal Corp. of Chicago, which has also produced extensive sign programs for turnpikes in the States of Connecticut, Missouri, Kansas, Oklahoma and Kentucky.

JOHN B. MALLETTE,
Fay, Spofford & Thorndike, Inc.,
Consulting Engineers,
Boston, Mass.

THE PROBLEMS OF SMALL BRIDGE DESIGN

SMALL BRIDGES may not have the glamor and appeal of spans across mile-wide canyons or large bodies of water, but they are equally important. Today, they are being built in record numbers, and still more will be needed in the future to carry traffic across limited access highways, to decrease congestion at in-town intersections, to eliminate railroad grade crossings and to carry oil, gas, and water pipelines to major centers of population.



● **BOSTON'S Central Artery, like many overhead expressways, is essentially a series of bridge spans supported on piers and piles, often with relatively short spans.**

The Federal Highway Program alone will result in the need for thousands of small bridges, as will the continued construction of toll roads and urban expressways. The Massachusetts Toll Road has over 100 bridges along its 123 mile length. There will be 16 bridges in the 6 mile length of the Cook County Northwest Expressway from its terminal point in uptown Chicago to its connection to the Northern Illinois Toll Road at O'Hare Municipal Airport. In the next few years there probably will be one bridge built for every one or two miles of express highway east of the Mississippi, and one bridge for every two to four miles of express highway in the country as a whole.

For the shortest spans the simplest type of bridge structure, and generally the most economical, is one having a reinforced concrete slab deck that carries load without aid from secondary supporting members; when designed to carry vehicular traffic, the deck may be up to 15 to 18 inches thick, and usually is limited to 35 ft. in length. Such bridges are commonly used only for spanning small streams, railroad tracks, narrow access roads or pipe lines. Since substantial forms must be built under the deck to support the concrete while it is in a plastic state, construction cost may be prohibitive if travel beneath the structure must be maintained during construction. By far, the most popular use of slab construction is in the familiar box culvert which can be constructed "in the dry" by diverting the stream. Under high embankments, these structures become quite heavy, but when used properly they are more economical in both initial cost and comparative maintenance than the typical deck bridge.

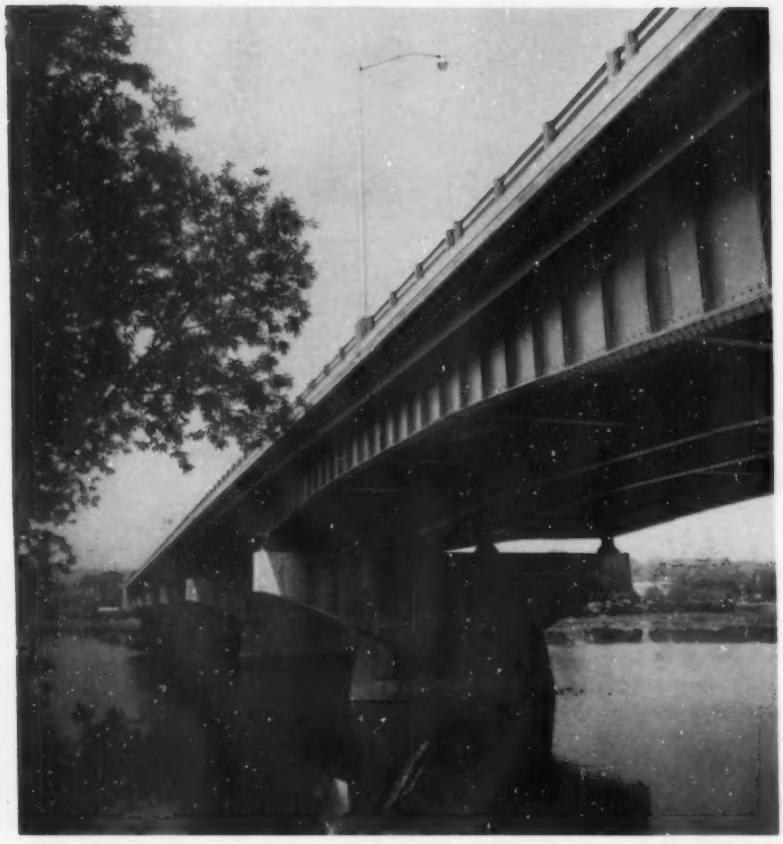
Concrete Bridges

To minimize the disadvantage of a poured deck, short precast units can be used instead. The units may be cast as inverted U shapes of reinforced concrete. These are placed into position quite easily with standard crane equipment and then bolted together side by side to equalize loading. Economy is a big advantage in this type of construction especially when forms are available and the cross-section design is repeated in the members. This type of structure is usually confined to spans of less than 30 ft. with modern highway loading.

For spans above 30 feet, prestressing has made concrete competitive with steel under certain conditions; has extended the effective span of the precast units from 30 ft. to 45 ft., an increase of 50 percent; and has permitted a deck type design using deeper sections that can be used on spans up to 70 feet. Because of the number of joints and the fact that the top surface is flat, a bituminous concrete surface, crowned to insure proper drainage, is usually placed over the decks.

But perhaps the most popular type of concrete span in the range of 50 to 100 feet is one comprised of concrete I-beams, either reinforced for short structures, or prestressed for longer structures. Such beams can be easily dropped in place and covered with a poured concrete deck. Usually, the beams and deck can be designed as a composite structure, in which case the beams are notched, keyed, doweled, or rigidly attached to the deck by other means in order to allow the deck slab itself to act as part of the supporting member rather than as dead load alone.

Prestressed concrete sections can be cast on the site at a schedule con-



● **PLATE girder spans, with a secondary system of stringers and cross-beams to support part of the loads, were used on the Passaic River Bridge, E. Paterson, N. J.**

trolled by the contractor. If a large number of bridges are to be built near one location, the use of prestressed concrete may result in a substantial savings in cost. On the other hand, prestressed concrete is economically impractical unless a sufficiently large number of similar members are to be cast to justify the construction of forms and the acquisition of necessary accessory equipment. Neither is it practical for curved roadways or for continuous spans. Futhermore, there must be close control of the concrete mix, and equally meticulous control of the tensioning pressures and curing cycles. Curing, as a matter of fact, requires 24-hr. supervision—a fact that discourages many contractors.

Steel for Bridges

The simplest type of steel structure consists of simple beams or stringers supported at both ends beneath a roadway deck. This design, quite popular 35 or 40 years ago, is still extremely common. Smaller members were usually preferred 50 years ago. The technique was to design enough members into the structure to obtain the required strength; thus, a number of small beams, placed side by side and spaced across the width of the structure, would carry fairly heavy loads. Today, because of high cost of construction and the increasing weight of highway vehicles, it is more efficient structurally to use fewer but larger stringers except when clearance is a problem. Rolled members up to 36 inches in depth are available from the mills and can be used for simple spans up to 85 ft. in length. In multi-span structures, this length can be extended by continuous span construction to about 110 feet. Continuous span construction is satisfactory under many circumstances, and often is used in preference to plate girders or additional center piers, both of which increase bridge cost.

Similar to concrete, steel members can be tied to the concrete deck for composite action. In this case, the deck is attached to the stringers by a shear connection, such as a steel spiral; short pieces of bulb angle or channel sections welded across the top of the beams; or—the latest innovation—shear studs that can be welded with automatic equipment.

When beams of normal rolling depth are inadequate, plate girders are usually the answer. These are the same general shape as rolled members, and, from a structural standpoint, act in the same manner. Being larger, however, they are capable of spanning greater distances or supporting heavier loads. They have been used in depths up to 20 ft., although 14 ft. is usually the normal shipping maximum. Plate or built-up members can be used in both simple and continuous construction to substitute for a rolled member of greater depth.

A secondary steel system, consisting of short stringers and cross beams, supports part of the load received from the floor beams and transmits the remainder to the girders. This stringer—floor beam—girder system is a railroad innovation but, except in certain circumstances is considered to require a considerable amount of steel and also complex fabrication in construction. It was recently used by Fay, Spofford & Thorndike for the Passaic River Bridge on the Garden State Parkway in New Jersey. The reason: long spans, poor foundation conditions, a wide roadway, and heavy loading. Today, when a span exceeds 300 ft., the usual design procedure is to consider another solution.

Of course, truss structures can be used instead, but when they are the bridge generally falls within the large category. For carrying long spans over deep canyons or large bodies of water, it or a suspension bridge provides the load carrying capacity that is required in a modern structure; the suspension design is almost always restricted to high level bridges, since the fact that it can be built from the cables down makes it economically justifiable in such instances.

Fundamentally, a truss structure acts in the same manner as an extreme deep beam. In the old days, the practice was to use smaller members and to combine them in a truss structure to get the effect of deep beams. Today, the trend is toward more piers or larger beams, but as a beam or plate girder increases in length, deadweight alone makes it imperative to remove metal at areas of low stress—and this is nothing more than a "single-member" truss.

It is dangerous to make generalization about trends, but it is safe to say that more piers are being used for small bridges today than ever have been in the past. The appeal of double-barreled highways with the

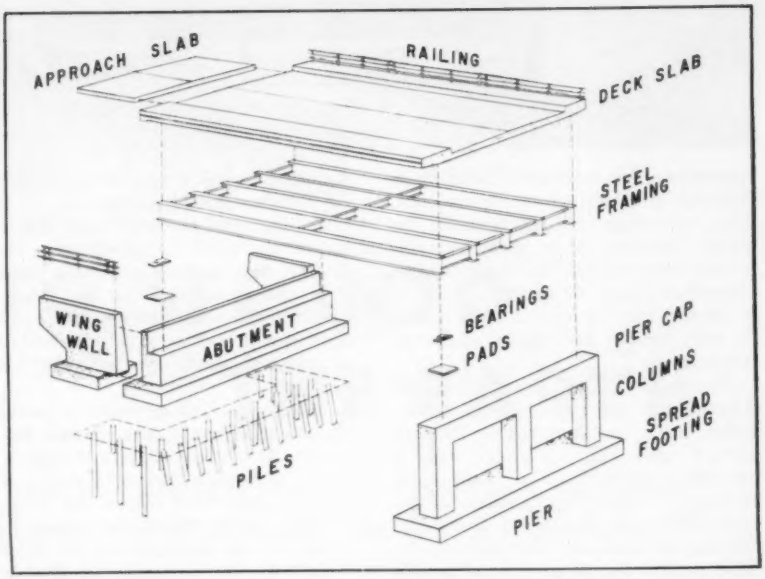
resulting need for viaduct structures is one of the most significant reasons for this. Theoretically, the number of piers depends on geometric considerations, characteristics of the selected structural material or type of construction and foundation conditions, to name a few. These all come down to economics and practical considerations such as designing the best structure for a specific job.

But the client's engineers may, for engineering or aesthetic reasons, want structures with more piers and less steel; or conversely, more steel with fewer piers. On the New York State Thruway, for example, a large number of piers were used for the bridges. On the New Jersey Garden State Parkway this was not the case, and more steel was used.

Piers and Abutments

Piers may take many shapes—they may be solid, open, light, heavy, rectangular, circular, T-shaped, arched, etc.; but basically there are four types: the solid, the T-shaped, the isolated column and the open column cap pier.

The solid type is used primarily for bridges across railroads and water. The idea of solid piers in water or in river beds is that they do not catch ice or debris and are less susceptible to damage by ice heaving. Naturally, when solid and massive, they are capable of withstanding extremely heavy thrusts by spreading those loads over a large area at the foundation. The idea of using them for railroad crossings, either as a full solid pier or as a partially solid pier, sometimes called crash walls, is that they are less susceptible to major damage if hit by a moving train. Unless the pier is hit head-on the train can slide along its width instead of catching a single column and doing major damage to the structure.



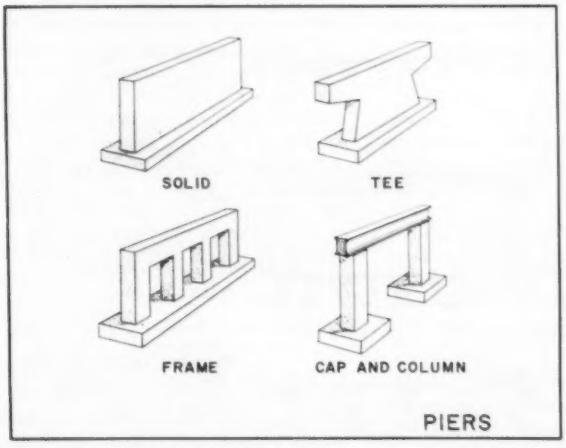
● **INDIVIDUAL components of a bridge collectively become the bridge. The balance and integration can result in a pleasing structure or in an unsatisfactory one.**

The selection of a solid vs a partially solid pier is primarily one of preference or taste. Both are equally effective for river or railroad crossings provided the solid section is carried to a sufficient height. The choice then must be based on a combination of engineering and aesthetic values.

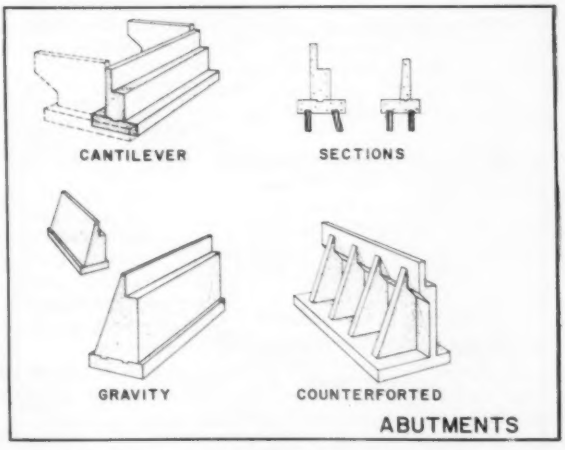
The T-shaped piers are employed for lighter structures since they are most effective when the bridge is narrow and the loads are relatively small. They have the advantage of a light, airy appearance and of modern design. As loads become heavier and the road bed becomes wider, they rapidly lose their shape since more material must be added to support the structure. Thus, today they are frequently used for underpasses on toll roads and expressways, and seldom used for railroad structures.

The isolated column pier, having a steel cap beam framing with the deck members, is usually used in areas where clearance is a problem. At a complicated interchange on a modern expressway, for example, it may be necessary to pass traffic within the spacings of the columns. Construction of this type was used extensively in building the Boston Central Artery.

An abutment is simply an end pier. It has a secondary function in that it usually acts as a retaining wall for the adjacent ground and,



● **PIER types: Selection is often based on mere preference; but local conditions may determine which type should be used.**



● **THREE basic types of abutments are shown. Factors in selection are discussed on this and the following text page.**

● **THIS two-span plate-girder bridge is 128 feet long between the abutments.**

therefore, the horizontal loading is heavier than on an ordinary pier. But, otherwise, it must perform the same function as a pier, namely, supporting the load from the bridge. Abutments may be made of stone or concrete, but the use of stone today is very limited for purely economic reasons.

There are three basic forms of abutments: the gravity wall, cantilever wall, and buttress or counter forted wall. The gravity wall is nothing more than a dam type structure usually perpendicular on the front and sloped on the back, having a relatively massive weight that retains the fill or cut. Although not a popular design, a gravity wall is much more economical for low abutments. Usable in heights up to 17 or 18 ft., it can, of course, be reinforced and used for higher sections. But, from a practical standpoint it is generally limited to short, squatty structures; again, engineering preference has a direct bearing on the style.

The cantilever type is good in heights up to 28 ft. It has a heavy base from which a reinforced concrete wall extends upwards acting as a cantilever beam rotated to the perpendicular. Naturally, the cantilever wall can, from the structural standpoint, be used to practically any height, but economic factors enter into the considerations and above about 28 ft. it becomes necessary to lighten the abutment by eliminating masses of concrete that are not critical.

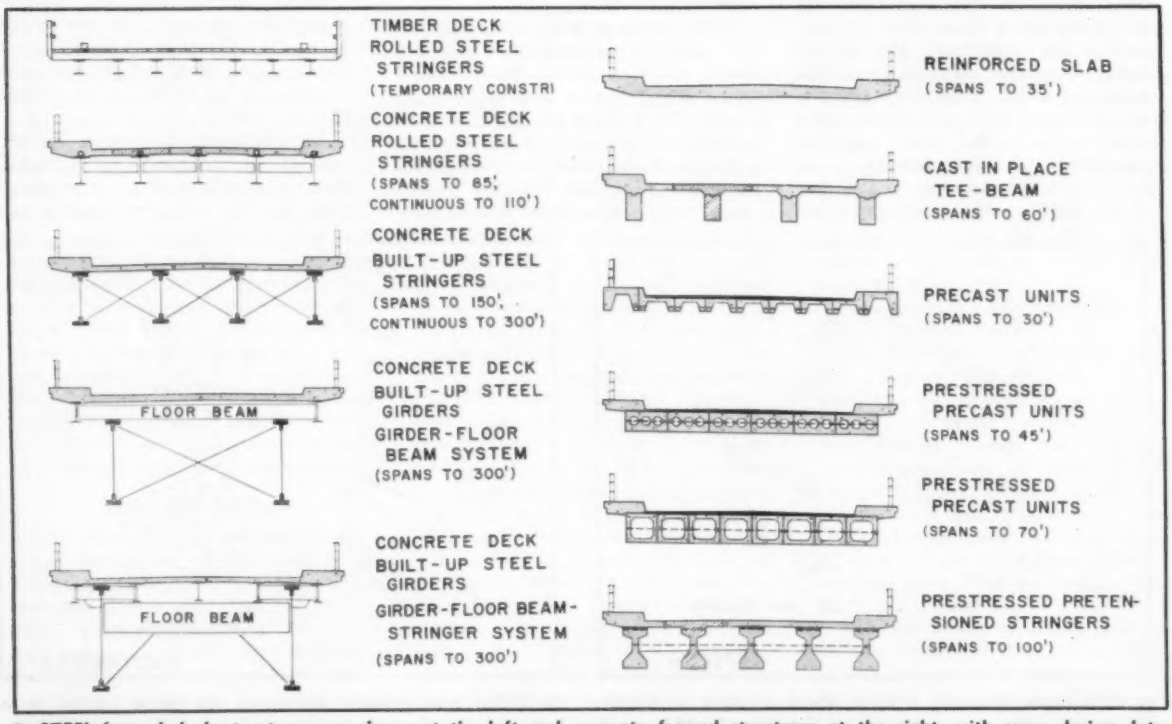
The buttressed or counter forted abutment consists of a simple vertical wall with struts of a triangular shape to handle horizontal forces. It is commonly used where the height exceeds 30 ft. When the triangular struts act in compression, the word "buttress" is used; when in tension, the word "counterfort" is designated.

Wing walls, commonly termed retaining wings, may extend straight out, may be flared back or may be U shaped with the latter being parallel to the bridge approach. In fact, there is any number of variances to these established designs and all can be considered practical if they do the job. Basically, walls flaring back approximately 45° are the most economical. The U shaped is the most expensive, but for justified aesthetic reasons, is the most popular. It is possible, of course, to combine one type of wing wall with a different type of abutment, but generally this is not done. For construction simplicity, the same types are usually employed.

Piles for Piers

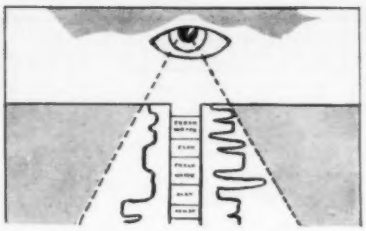
A pier or abutment may be placed directly upon the earth. The decision to do so, however, must be made by an experienced soils engineer who, by mechanical tests and through experience, can determine the load-carrying ability of the soil.

Again, as loads become heavier and soil capacity lessens, piles become necessary. These may be steel or concrete. Until recently, steel has been preferred, but concrete is being used increasingly. There are two types of concrete piles: the precast, reinforced type that is driven in the same manner as a steel pile, and the poured-in-place concrete pile. This latter is made by driving a hollow steel section, either smooth or corrugated, using a mandril, to the required depth, reinforcing it if necessary and filling it with concrete. For short lengths, this is the most economical, although it is limited in loading, usually to 40 tons.



● **STEEL-framed deck structures are shown at the left and concrete framed structures at the right, with some design data.**

A WAY TO SEE INTO THE EARTH



Geophysical logging of water wells and test holes can provide information on subsurface conditions which is of great value to soil mechanics engineers and the water supply industry.

SOME OF our resources obligingly exist on the surface of the earth; some, such as ground water and oil, must be obtained from hidden subsurface areas and are not easily appraised or harvested. Also, the subsurface becomes important when we erect dams, bridges, runways, highways or heavy buildings, in order that they may be constructed in accordance with the earth's capacity to support them.

Geophysical logging of borings is a practical means of obtaining reliable data on the undisturbed earth near the walls of a bore hole. A geophysical log is to a geologist and engineer what an electrocardiogram is to a physician. For 20 years the oil industry has been making increased use of these techniques of learning about the physics of the deep subsurface. The practice is now routine in oil technology. Geophysical logging in water wells and test holes is becoming common in the United States, particularly in the Gulf Coast, but it is still a baby, though healthy and growing, to the soil mechanics industry.

Much of the information sought by oil geologists and engineers, and at least partly achieved through geophysics, is the same as that sought in the ground-water industry and by soil mechanics engineers. The oil industry was a natural for geophysical logging. It needed information badly; it had the technical people to use the data; it had the money to pay for the services and also to pay for the years of necessary research and development. However, good water wells are expensive, too, and it is important that the per gallon cost of water is as low as feasible. This is achieved best by wells that are properly adapted to prevailing geology and hydrology. Also, soil mechanics engineers work on support problems where the stakes are obviously high, where error or decisions based upon inadequate information can be ruinous. These industries need only to appreciate better what geophysics can do, and how it can save them money and at the same stroke improve their results.

Basis and Purpose

Geophysical logging techniques are based on the premise that there are measurable differences in the physical-chemical properties of geologic formations. The measurement of these differences and the recording of them on a chart correlated with depth result in a geophysical log. Logging is accomplished by lowering a sonde down the length of a bore hole. For electric logging the sonde is a two-inch lead and rubber cylinder about 30 inches long. For radioactivity logging the sonde is a stainless steel tube, also two inches in diameter, approximately five feet long, containing the gamma ray detector and signal amplifying device. Electrical signals in each logging operation are sent up the cable to an amplifying, converting and recording instrument at the surface.

Naturally, geophysical logs of boring yield the same type of information without regard to the purpose for which the boring is made. This includes:

1) Formation thicknesses and depth of the contact between one formation and another, accurate to a fraction of a foot. Also, whether the contact is sharp or gradational.

2) Certain changes in porosity and permeability of beds, and thin variations within a single bed. Inversely, the relative density and clay content of beds.

3) True top of the zone of saturation. Also, vertical changes in the mineral character of ground water.

4) The occurrence of thin beds such as lignite or peat (under usual conditions) within an otherwise massive formation.

5) The detection of leaks in casings and of zones in an uncased hole where water may enter or leave the boring.

6) The detection of zones of greatest water-yielding ability; for example, the occurrence of a highly permeable clean sand zone contained in a massive silty-clayey sand.

7) Basis for correlation of geology between bore holes for the purpose of determining geologic structure. Many geophysical logs show "marker" horizons suitable for geologic correlation that are not detectable by study of cuttings or cores.

8) Identification of type of soil or rock material and minute vertical changes in such material.

9) Recognition of the thickness of land-fill or disturbed earth overlying firm material below.

Method of Operation

Geophysical logging equipment designed for operation to depths of 50 feet to 1500 feet is available commercially. Instruments are normally carried in a station wagon or are transportable by commercial aircraft for operation at distant points.

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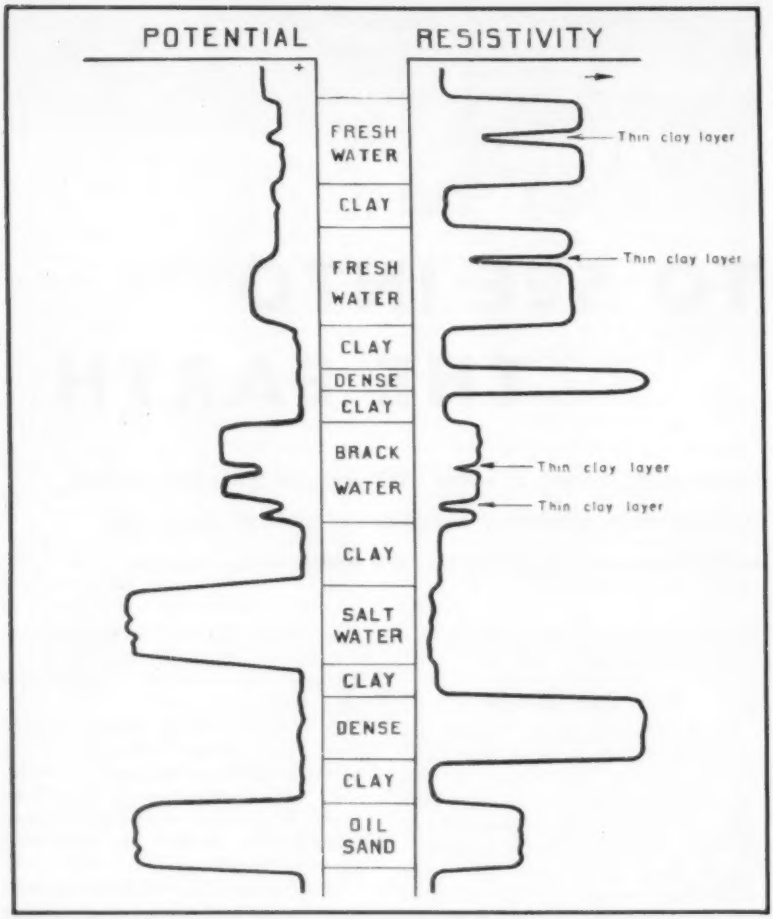

● **FIG. 1. An idealized electric log illustrating the behavior of the electrical curves in a variety of materials. This is the most widely used type of electric log.**

Power is obtained from a portable 1500-watt gasoline driven generator. Raising and lowering of the sonde is achieved by a variable speed electric winch. Recording paper moves in response to the reeling of the cable. For work to depths down to 200 feet a vertical scale of one inch of record per five feet of logging can be used. Smaller scales are better for greater depths.

Electric Logs—The most widely used form of geophysical logging results in two or more curves which represent the electrical characteristics of the beds penetrated by the bore holes. Fig. 1 shows an idealized electric log and illustrates the behavior of the electrical curves in a variety of materials.

The spontaneous potential curve, customarily appearing on the left side of an electric log, represents vertical variations in the amount of natural electric current in the bore hole. The amount of current measured at any given portion of a bore hole is the sum total of positive and negative fields of current, some of which are natural to the earth at that depth without regard to the boring. Other electrical fields are a result of electro-chemical action between the fluid in the bore hole and the natural formation waters. Permeable material usually shows a negative spontaneous potential, particularly if the drilling mud has a higher resistivity than the formation water, as a fresh drilling fluid in a hole penetrating a slightly more mineralized water formation.

The resistivity curve, customarily appearing on the right side of an electric log, represents vertical variations in the ability of the earth material to resist the passage of applied electric current. The diameter of the cylinder of earth actually measured at any given depth in the boring depends upon the technique employed, but is generally several feet. Shale, clay and other fine-grained material have relatively low resistivity. Clean sand, gravel and sandstone containing fresh water, and dense crystalline rock normally show high resistivity. There are many gradations in between.

Complete electric logs can be obtained only in uncased holes and are best in borings containing water or drilling mud. By using a special "dry wall" electrode, which makes a direct brush contact with the earth wall in the bore hole a satisfactory resistivity curve can be obtained in a dry boring. In water wells containing surface casing good electric logs can be obtained in the portion of the well below casing. The potential curve in a well containing perforated casing or commercial well screen can show the location of openings in the casing or well screen.

Gamma Radiation Radioactivity Logs—Virtually all earth material contains elements in the process of radioactive disintegration and which emit gamma rays. The gamma ray curve of any geophysical log is a record of the vertical variations in the intensity of gamma radioactivity in the formations surrounding the bore hole. The intensity of radiation is low in the case of white quartz sand, is relatively high in clays and shales, and particularly high in dark colored, fine-grained beds.

Fig. 2 shows an actual geophysical log near San Diego, Calif. by Associated Stratigraphic Services for Dames and Moore, Soil Mechanics Consultants, Los Angeles. The gamma radiation curve appears at the extreme left. Minor deflections in the gamma curve are caused by variations in cosmic ray activity and other background radiation and do not repeat exactly on a second run. However, the important features of the log repeat accurately. Note the relationship between the gamma curve and the curves of the electric log.

Gamma radiation can be measured without regard to the presence of casing or water or drilling mud. Therefore, these logs are obtainable in any bore hole or shaft at least three inches in diameter, cased or open-wall, wet or dry.

Gamma curves are well adapted to correlation work, the analysis of geologic structure by correlating "marker" horizons from one bore hole to another. They are also suitable for showing thickness of beds and the occurrence and concentration of dense, dark clays.

In addition to electric and gamma ray logging, other techniques have their place in the ground-water and soil mechanics industries. These include: neutron logging, a measure of the dampening effect of forma-

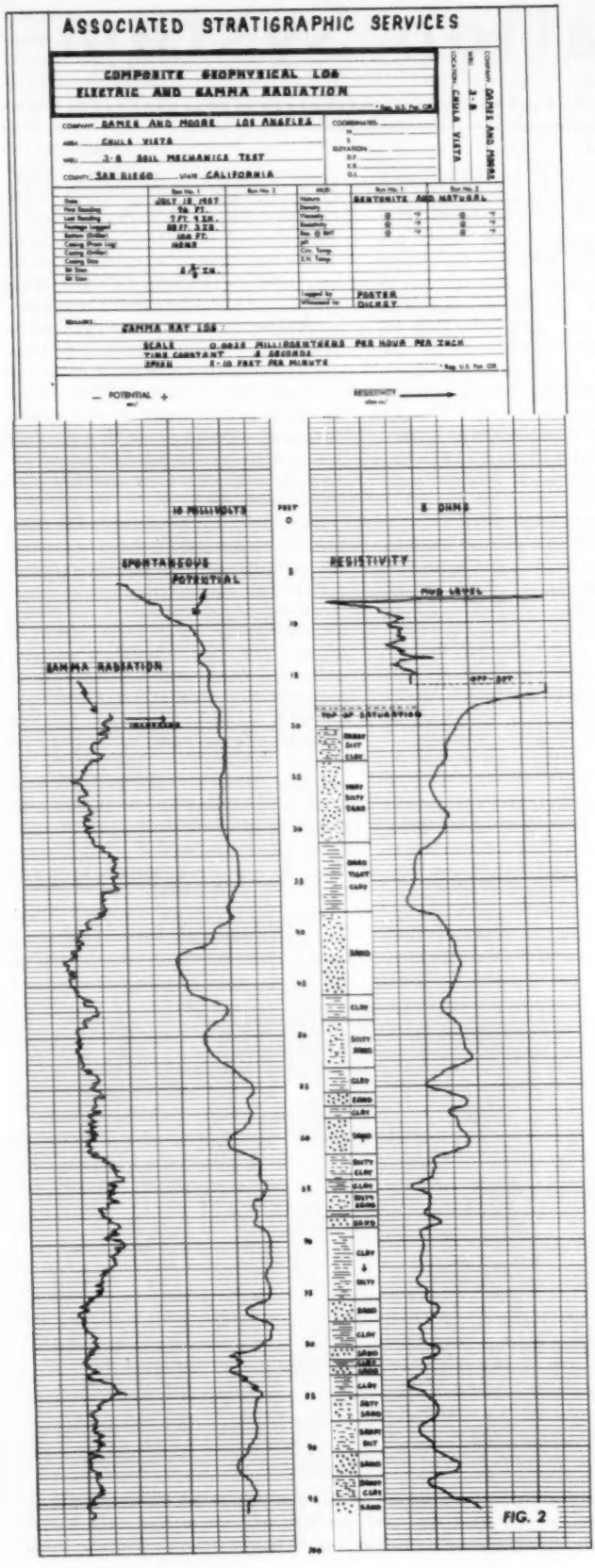

FIG. 2

tions upon radiation from an artificial source of radioactivity (gamma emission); caliper logging, a measure of the changes in the diameter of an uncased bore hole as an indication of formation stability; use of radioactive tracers for measuring ground-water movement and transmissibility; temperature and fluid resistivity logging, a measure of vertical changes in temperature and resistance of bore hole fluid; flow meter survey, a measure of changes in the rate of vertical movement of water in a well being pumped or in a well into which water is being added at the top; and well photography, a means of obtaining pictures of the geology in a bore hole or pictures of casing and screen.

Ground-Water Industry Benefits

Properly interpreted, geophysical logs can indicate zones of maximum transmissibility and thus guide the length and settings of well screens and perforations in casing in unconsolidated material containing sand and gravel aquifers. Results are better well efficiency, lower construction cost and maximum length of life. The zones best suited to shooting or under-reaming can be selected with resulting more efficient well treatment for improved specific capacities.

By comparing the physical properties of aquifers at several test hole locations the best area for permanent well construction can be selected. Thus wells or well fields can be located in areas where specific capacities are potentially greatest.

The chloride content of ground water can be appraised when properly integrated with scattered chemical analyses, showing the relationship between chlorides and total dissolved solids. Certain formations or portions of formation can be avoided in well construction by this information. As a result, well fields can produce water of better mineral quality.

Use of existing geophysical logs of wildcat oil tests through a wide area enables Federal or State geologists to appraise ground-water resource conditions in a large region and to guide large water-using industries and municipalities in directions best suited to expanding ground-water withdrawals. Fortunately, many oil producing states require the filing of geophysical logs and other geological data in depositories where they are available to anyone. Also, commercial log libraries are common in cities which serve the oil industry.

Soil Mechanics Benefits

Where rotary (wash) borings are used in which split-barrel cores are taken at intervals a geophysical log run after completion of drilling indicates the degree to which a core is representative of material above and below the sampling zone. Example: a one-foot core taken anywhere in a bed that shows uniform electrical and radioactivity properties is virtually certain to be representative of that entire bed. However, the sample would not be representative in a ragged formation that shows contrasting geophysical properties.

A geophysical log indicates the degree to which penetration (blow count) characteristics of a certain level are representative of material above and below the level tested.

The cost of core sampling can be reduced in many instances by reducing the number of sampling points, justified by the geophysical records that are continuous through the entire depth of the boring.

(*Continued on page* 148)

The Biofiltration System—

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HIGH RATE trickling filters of the biofiltration type ar those in which some portion of the filter discharge is returned to the influent of the primary sedimentation tank where it joins the raw sewage. The filter discharge may be settled or unsettled or both prior to return, depending on the flowsheet used. Biofiltration plants can be designed to give any degree of treatment between sedimentation and complete treatment. Biofilters are usually dosed at 5 to 10 times the rates employed on low rate filters, and with careful design, they can produce an effluent as low in suspended solids and BOD as a low rate filter but with little, if any, evidence of nitrification. It is usually the function of the pollution control authority to decide whether a nitrified effluent is necessary or whether simply adequate BOD and solids reduction is expected.

Flowsheets

Flowsheets most frequently used in biofiltration plants are shown in Fig. 1, *a* to *f* inclusive. For single stage operation, Fig. 1b is preferred because the two clarifiers, primary and final, can be the same size and the humus sludge is returned with recirculation liquid to the primary clarifier without a separate sludge pump. For two-stage operation, Fig. 1c is now most widely used for several reasons. With the secondary recirculation ratio (R_2) made to equal to $R_1 + 1$, the average flow to primary and final clarifiers is equal and hence both can be the same size. In this flowsheet, where some of the primary settled effluent goes direct to the second filter, a progressive feed condition is established and the filters are more evenly loaded. Total head loss through the plant is the least of the two-stage flowsheets shown, generally not more than 3 feet greater than in a single stage plant.

Many earlier plants have successfully employed two-stage flowsheets 1e, in which the flow from the primary filter passes unsettled to the second stage filter, and a number of plants are still being designed with an intermediate clarifier as shown in Fig. 1d. The operation of filters in stages without intermediate settling would seem to have an inherent weakness in that waste products from the first filter must pass through a second filter before being removed from the system. However, judging from the number of plants which are operating successfully without intermediate settling, the weakness, if present, is of negligible consequence. The use of an intermediate clarifier as in flowsheet 1d is not justified unless the sewage is very strong with high initial BOD (over 300 mg/L). With normal sewage (200 mg/L) and the first stage properly designed and performing as it should, there is too little work remaining for the second stage filter to do, and it apparently becomes starved. Fig. 1f is used where intermediate treatment is acceptable, where an effluent must be somewhat better than sedimentation alone, or to reduce the load on existing biologic treatment.

The choice of flowsheet is dependent upon several factors including the strength of the raw sewage, the quality of effluent desired and, to some extent, on the size of the plant. For treatment of normal strength sewage (200 mg/L BOD), with adequate primary sedimentation, and recirculation ratio of 1.0, Flowsheet 1a or 1b may be relied upon to produce an effluent containing 25 to 30 mg/L BOD. For treatment of stronger than normal sewage and when an effluent of 30 mg/L and lower is desired, two-stage treatment is recommended with Flowsheet 1c preferred, although either 1d or 1e may be used.

In a plant where multiple filter units are required because of size, local requirements or other reasons,

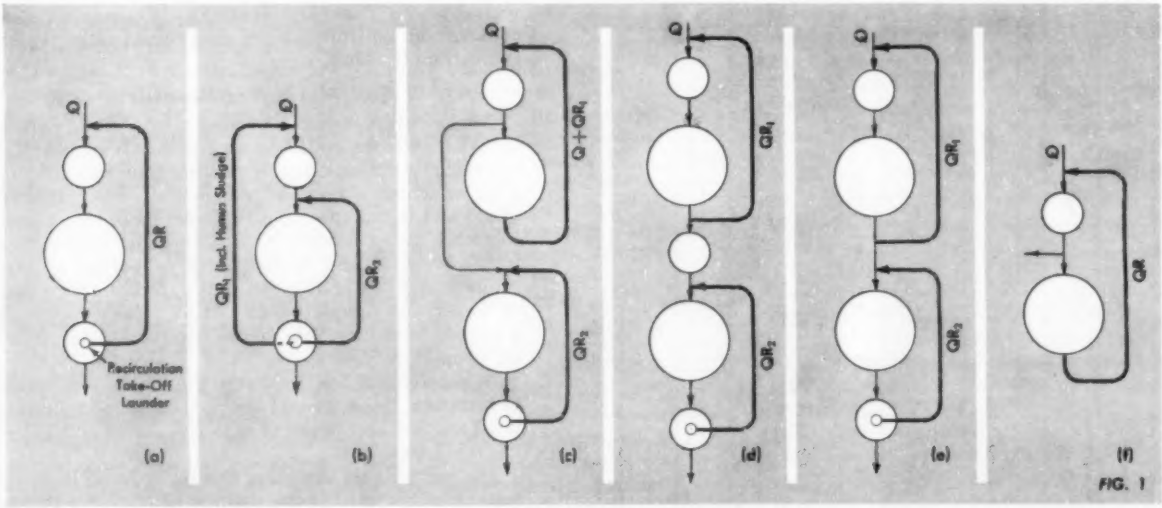


FIG. 1

● **TYPICAL Biofiltration flowsheets. (a) and (b) are single stage; (c) is two stage with progressive feed; (d) and (e) are two stage and (f) is single stage, intermediate. Sludge lines are not shown except as noted in (b). In all flowsheets humus sludge from the final clarifiers and intermediate clarifier is returned to the influent line of the primary clarification tank.**

it is frequently desirable to arrange for two-stage operation at small additional cost, particularly when using Flowsheet 1d.

Flowsheet 1f is used to provide treatment intermediate between sedimentation and complete treatment. No secondary clarifier is provided but the primary clarifier is enlarged to handle the added recirculated flow.

Primary Sedimentation

In any biologic sewage treatment plant provided with initial sedimentation facilities, a certain percentage of the BOD in the raw sewage will be removed with the solids which settle. Where there is no recirculated flow passing through the primary clarifier, an analysis of the influent and effluent will provide the answer, but when flow is recirculated, this procedure will not give correct results. Moreover, it is generally necessary to estimate this removal during design or before the plant is built. The usual method is to estimate the BOD removal due to primary sedimentation on the basis of clarifier overflow rate. The Ten States Standards[1] include certain allowable removals due to primary sedimentation which are as reliable as any available. The size of the primary clarifier is usually selected on the basis of average 24-hr. raw sewage flow plus recirculated flow returned to the clarifier influent.

Recirculation

In biofiltration plants, some form or pattern of recirculation is always used. The ratio of the volume of flow recirculated to the volume of average raw sewage flow is defined as the recirculation ratio R. Where more than one recirculation means is used in a plant, the ratios are distinguished as R_1, R_2, etc.

The beneficial effects of recirculation have been amply demonstrated but some may wonder how an increased filter loading which must occur when flow is recirculated can result in reduced BOD in the plant effluent. This may be explained by reference to the Ten States Standards. In discussing permissible filter loadings these Standards consider reduction in BOD through a high rate filter followed by settling to be two-thirds of the applied load including recirculation or, alternatively, the effluent is one-third of the influent (within certain load limits). Applying this statement:

Let F = BOD in settled raw sewage, lb./day;

L = BOD in recirculated flow, lb./day;

F + L = Total BOD applied to filter, lb./day;

$\frac{F + L}{3}$ = BOD in settled filter effluent, lb./day, before recirculation takeoff.

Final effluent, E, after recirculation take-off is $E = \frac{F + L}{3} - L = \frac{F}{3} - \frac{2L}{3}$, which is less by 2L/3 lb./day than a filter with no recirculation (F/3). For example, assume F = 180 lb. and L = 45 lb.; $E = \frac{180}{3} - \frac{2 \times 45}{3} = 30$ lb. With no recirculation, $E = \frac{180}{3} = 60$ lb.

In determining the recirculation ratio R in a single stage plant using Flowsheet 1b, the sum of R_1 and R_2 is treated as a single value R in determining performance. In computing the size of the final clarifier in this flowsheet, the QR_1 recirculation is deducted from the total flow from the filter because this flow is removed from the final tank at the bottom and hence does not appear as overflow. Only QR_2 recirculation plus the average 24-hr. flow of sewage are considered.

In this connection, the importance of continuous removal of humus sludge from the final clarifier is emphasized. Humus sludge, if allowed to accumulate, quickly becomes septic and depletes the oxygen in the final clarifier. This is one advantage of Flowsheet 1b which combines recirculation with humus sludge removal.

Return of recirculated filter effluent to the raw sewage has proved beneficial in reducing odors particularly in initial stages of plant operation when the sewage flow is frequently much below design conditions and often septic. Recirculated flow is also effective in reducing scum particularly when treating stronger sewage.

Predicting Results

When laying out new high rate filter plants, designers need to estimate or predict their performance. This can be done with reasonable confidence through the application of certain formulas developed from analysis of operating data from existing high rate plants. It should not be concluded that sewage treatment has become an exact science with precise performance predictable by formulas. Such formulas do, however, serve as a tool or guide to the experienced designer. One such formula is derived from the Ten States Standards on high rate filters. These state that, for single stage plants, "the recirculation system shall supply sufficient dilution to the settled sewage so that the BOD of the influent of the filter, recirculation included, shall not exceed three times the BOD of the required settled effluent." Another way of stating this is that in a single stage plant the BOD in the settled effluent of the filter may be expected to be one-third of that in the influent, recirculation included. This is applicable to filter loadings up to 4800 lb. of 5-day BOD per acre ft. per day which is equivalent to 110 lb. per 1000 cu. ft. or 2.97 lb. per cu. yd.

The formula for single stage plants derived from the foregoing principle is as follows:

$$E = \frac{C}{2R + 3}$$

in which E is BOD of settled effluent, C is the BOD of the settled raw sewage and R is the ratio of recirculated flow to raw sewage flow. Values of E and C may be in milligrams per liter lbs. per day, or pounds per unit of volume of filter media. Another way of stating the expected performance is as follows: Percent of applied BOD in settled effluent = $100\ [0.5 \div (R + 1.5)]$. Expected performance of single stage filters on the basis of the foregoing formula is shown in Fig. 2.

Another method of predicting performance preferred by some designers is on the basis of the NRC formula[2] developed specifically from trickling filter installations serving military bases in World War II. For single stage filters this formula is as follows:

$$E = \frac{100}{1 + .0085\sqrt{\frac{W}{VF}}};$$

in which

E = percent efficiency of BOD removal of the single-stage filter and accompanying clarifier;

W = applied BOD loading in lbs. per day of settled raw sewage;

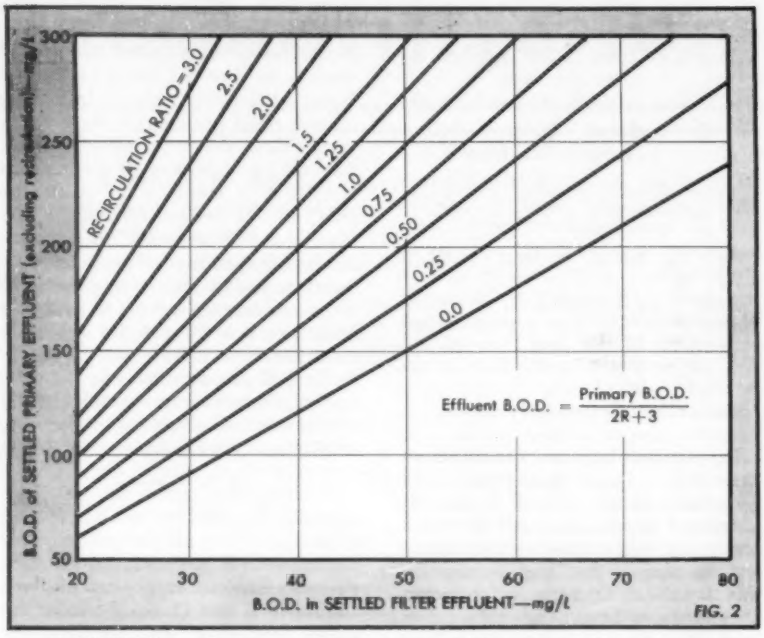
V = volume of filter media in acre ft.;

F = recirculation factor $= (R + 1) \div (0.1R + 1)^2$;

R = recirculation ratio.

This formula may be diagrammed to show remaining percentage of BOD with various loads and recirculation ratio as shown in Fig. 3.

The two formulas in the evaluation of single stage plants will yield identical performance results at certain loadings and recirculation



● EXPECTED performance of single stage trickling filters with recirculation.

values; and not widely different results generally.

Two Stage Plants

Two stage plants are likewise susceptible of analysis which will give predictable performance data. Flowsheet 1c for two stage plants is an important one to use for illustration. The first stage is similar to flowsheet 1f for intermediate treatment and the second stage is similar to a single stage filter and clarifier combination. In analyzing the first stage it is assumed that the average sewage flow Q must pass through the filter and that recirculation is any excess over and above the Q flow. With no excess the recirculation is zero. Considering the recirculated flow as QR, the total flow through the filter is, therefore, Q + QR, and as it is all returned to the primary clarifier, the latter must be designed for a total flow of Q, the average raw flow, plus the recirculated flow Q + QR, or a total of 2Q + QR. This increased capacity of the primary clarifier serves in place of a separate clarifier for settling the filter effluent. The difference is that this settled filter effluent constantly unites with the raw sewage thus resulting in a substantial reduction in BOD of the raw sewage. The effluent of this first stage may be calculated by assuming a reduction of two-thirds of the applied BOD which is a mixture of settled raw sewage and settled filter effluent BOD. Expected performance of this first stage is illustrated in Fig. 4.

The second stage in this flowsheet receives a portion of settled raw sewage at all times thus utilizing the progressive feed principle used with success in activated sludge plants. This stage may be assumed to perform with the efficiency of a single stage plant and the final settled effluent calculated accordingly. The difference from the typical single stage plant is that the BOD in the feed is greatly reduced because of the performance of the primary stage. The final clarifier receives a feed equal to $Q + QR_2$ and the primary clarifier as noted receives a flow of $2Q + QR_1$. When $R_2 = (R_1 + 1)$ both clarifiers receive the same flow and hence can be the same size.

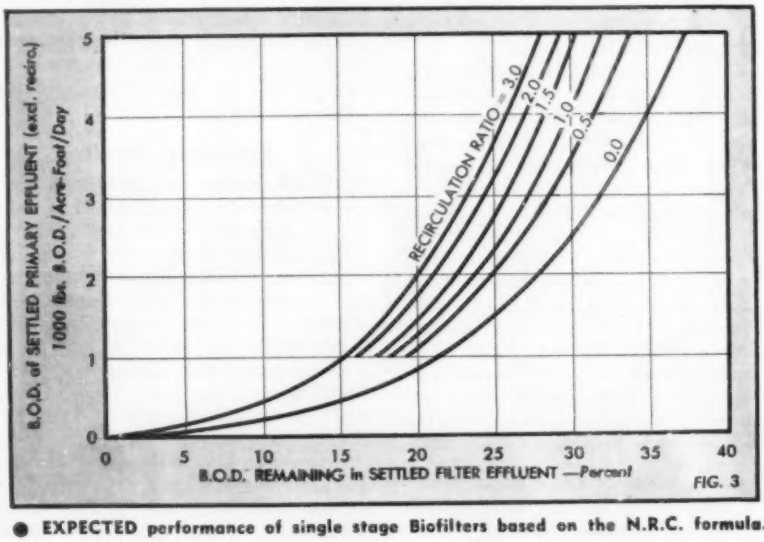
The effluents from two-stage plants using Flowsheet 1c are illustrated on Fig. 5. It is not unusual to obtain effluents of 10 to 15 mg/L BOD when using this flowsheet.

In the design of plants using two-stage Flowsheet 1c, the primary filter receives substantially a uniform flow and the secondary filter a variable flow caused by variations in the raw sewage flow. Hence the head required for the distributor on the second stage is greater than for the primary. For this reason the surface on the second stage filter is usually located 1.5 to 2.0 ft. below the surface of the primary. The diversion box following the primary clarifier needs careful hydraulic design to assure proper flow distribution with minimum head loss.

Two-stage filters can be also analyzed by a formula developed by NRC for military installations but it is too involved to illustrate readily by diagram. The writer has presented considerable data on actual performance of biofiltration plants together with calculated results in a paper published in Transactions ASCE[3].

Volume of Filter Media

The volume of filter media for single stage plants is usually based on estimated BOD load and allowable unit loading. Depths of 3 to 5 ft., and occasionally 6 ft. are used. Typical loadings are 2400 to 3000 lb./ac.ft. (55 – 67 lb./1,000 cu.ft.) of 5-day BOD per 24 hr. in southern latitudes and 2000 to 2400 lb./ac.ft. (46 – 55 lb./1000 cu.ft.) in northern latitudes. In two-stage plants, practice is



● EXPECTED performance of single stage Biofilters based on the N.R.C. formula.

to determine total volume of filter media required and divide it equally between primary and second stages. Depth of media is in the same range as for single stage plants. In most areas, regulatory agencies stipulate allowable loads on filter media.

Typical Problems

The solution of typical problems involving single and two-stage biofilters illustrates the application of the principles discussed.

Single Stage Filter—Assumption: Population 20,000, flow 2.0 mgd, BOD 0.17 lb./cap/day; effluent desired about 30 mg/L; BOD removal in primary clarifier = 1/3 of raw.

Use Flowsheet 1b with $R_1 = 0.5$, $R_2 = 0.5$, $R = 1.0$; raw BOD = 0.17 x 20,000 = 3,400 lb./day which in 2.0 mgd = 204 mg/L; settled BOD = 2/3 x 3,400 = 2,270 lb./day = 136 mg/L; expected effluent, $E = 136 \div [(2 \times 1) + 3] = 27$ mg/L (R of 1.0 is adequate).

This will result in an overall removal of 87 percent. Primary clarifier feed = 2.0 + 0.5 x 2.0 = 3.0 mgd. Assuming overflow rate of 800 gpd/sq.ft., the area required = 3,750 sq.ft. The secondary clarifier overflow volume is the same as the primary. Assuming the same overflow rate (800 gpd/sq.ft.), the area required is also 3,750 sq.ft. Therefore the primary and secondary clarifiers may be of the same size.

Biofilter applied BOD load (excluding recirculation) is 2,270 lb./day. Assuming loading of 2,400 lb./ac.ft. and a depth of 4.5 ft., the volume required is 0.94 ac.ft. and the area, 0.208 ac. = 9,100 sq.ft. Average dosing rate based on flow of 4.0 mgd $(Q + QR) = 19.2$ mgad. Applying these loadings to the NRC Formula and using Fig. 3, the percent of applied BOD remaining is 24.5 and the effluent will be 33 mg/L or an overall removal of 84 percent.

Two-Stage Filters—Assumptions are the same as for single stage but in this example apply the two-stage Flowsheet 1c, using $R_1 = 0.25$ and $R_2 = 1.25\ (R_1 + 1)$, with QR_1 and QR_2 0.5 mgd and 2.5 mgd respectively. Then referring to Fig. 5, the percentage of settled raw BOD remaining in the effluent is $100\ [0.75 \div (R_1 + 2.5)\ (R_2 + 1.5)]$, which in this example is calculated to be 9.9 percent or 13.5 mg/L. The effluent expected may be estimated at 10 to 15 mg/L. The primary clarifier feed $(2Q + QR_1) = 4 + 0.5 =$ 4.5 mgd. Using the same overflow rate as for single stage, the area required is 5,625 sq.ft.

Secondary clarifier feed $(Q + QR_2) = 2.0 + 2.5 = 4.5$ mgd or the same as for the primary. Using the same overflow rate as for the primary, the area required is identical, or 5,625 sq.ft.

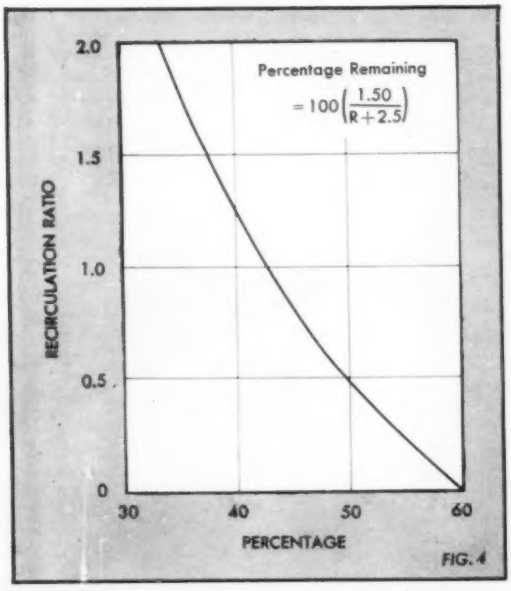
Biofilters—the applied BOD load (excluding recirculation) is 2,270 lb./day. Assuming a loading of 2,400 lb./ac.ft. and a depth of 4.5 ft. the total volume of filter media required is 0.94 ac.ft. and the area 0.208 ac. = 9,100 sq.ft. This is the same area as required for single stage. However, two filters are required each with 0.104 ac. or 4,550 sq.ft. in area.

The average dosing rate on the primary filter, with feed of $Q + QR_1$ or 2.5 mgd., will be 24 mgad. On the secondary filter with a feed of $Q + QR_2$ or 4.5 mgd. the average dosing rate will be 43 mgad. Although not abnormal, these dosing rates may be reduced, if desired, by assuming a lower BOD loading.

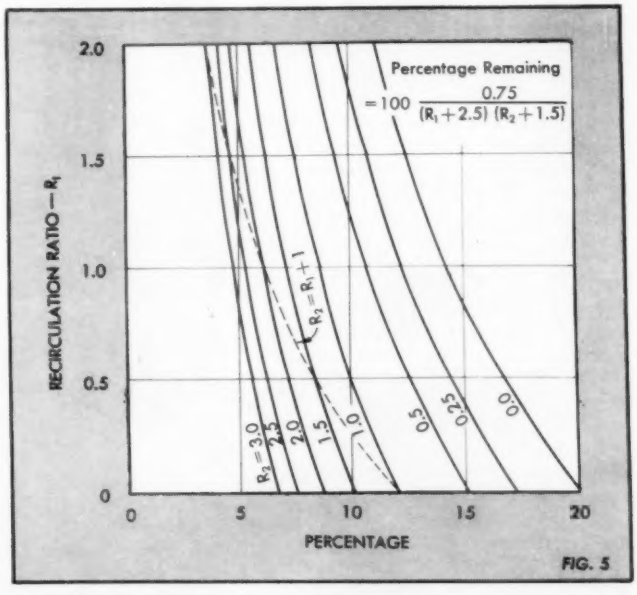
To obtain and maintain these calculated effluents in an operating plant is not difficult providing intelligence is used in the selection of materials and equipment going into the plant and in obtaining a qualified operator to run it. Such items as filter media, filter underdrains and rotary distributors are very important and specifications should leave nothing to chance. Correctly sized pumps, particularly for recirculated flows are also very important. Experience has demonstrated that properly designed, constructed, and operated biofiltration plants have little difficulty in obtaining results equal to the calculated performance.

References

1. "Ten States Standards for Sewage Works issued by the Joint Committee of the Upper Mississippi River Board of Public Health Engineers and Great Lakes Board of Public Health Engineers."
2. "Report of Subcommittee on Sewage Treatment in Military Installations." *Sewage Works Journal*, Vol. 18 (1946), Chapter V, Trickling Filters, Pg. 897.
3. R. S. Rankin, *Transactions American Society Civil Engineers*, Vol. 120, 1955. Pg. 823.



● **CHART of the expected performance of the single stage intermediate plant (Flowsheet 1f) showing percentage of settled raw BOD remaining in plant effluent.**



● **PERCENTAGE of settled raw BOD remaining in effluent of two-stage series parallel plant (Flowsheet 1c). It is not unusual to obtain effluents of 10 to 15 mg/L 5-day BOD when this flowsheet is used.**

DESIGN and CONSTRUCTION of Concrete Resurfacing

THERE ARE two principal reasons for replacing the surface of a concrete pavement: it may no longer be adequate for the loads imposed on it; or its surface may have deteriorated over a period of time and require rehabilitation of appearance and riding quality. Where the purpose is to add strength to an overloaded pavement, the resurfacing is usually referred to as "thick" or "normal" resurfacing. Where the purpose is to restore the surface riding qualities, the process is called "thin" resurfacing. Resurfacing used to increase the load-carrying capacity of old existing pavement may be bonded, but preferably bonding to the old pavement should not be required or specified. Thin resurfacing must be bonded to the old pavement to insure satisfactory performance.

Thick resurfacing operations closely resemble normal paving operations. For example, if broken pavement areas are encountered which require complete replacement, or locations on which sight distances call for revision of either vertical or horizontal alignment, operations can proceed without change of equipment. No major problems are encountered in switching from resurfacing to full cross-section and back to resurfacing.

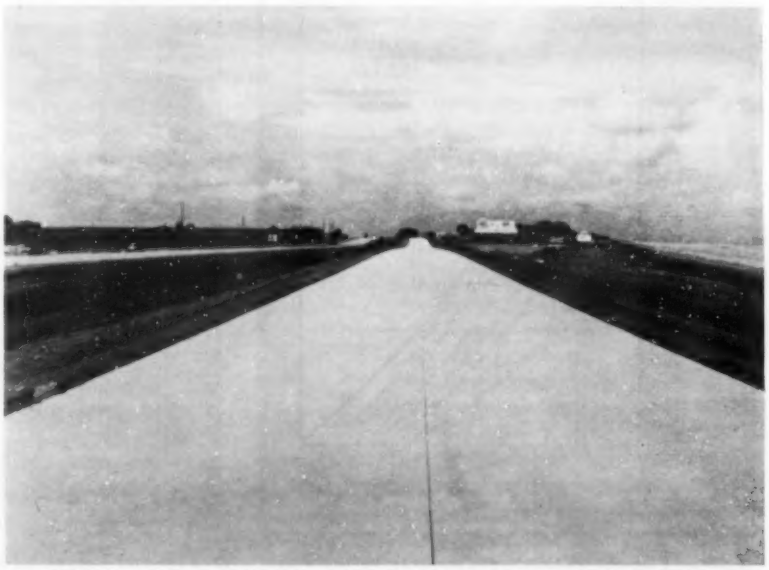
Design of Resurfacing

In the design of concrete resurfacing projects, thickness, jointing, and reinforcement must be considered. Since the pavement is likely to be quite old, widening may also be required, and must be designed.

In order to compute the thickness of concrete resurfacing needed, three factors must be determined:

1. The thickness and condition of the existing pavement.
2. The thickness of a new pavement adequate to carry the anticipated loads.
3. The presence or absence of a separating course that would pre-

● **27-YEAR old concrete pavement between Hudson, Wisc., and St. Paul, Minn., was resurfaced and widened to bring it to recognized modern standards of design.**



● **ANOTHER view of US 12, shown above. Utilizing the best in design and material, this highway was transformed into a four-lane, heavy-duty divided highway.**

vent bond or friction between the old pavement and the resurfacing.

If the old pavement and the resurfacing slab can be bonded so that they act as a single unit, and if the existing pavement has not developed structural breakage or deterioration, the total thickness of resurfacing and existing pavement needs equal only that of a single slab adequate to carry the expected loads.

If no bond can be obtained, the thickness of a single slag of equivalent strength would be the square root of the sum of the squares of the old pavement and the resurfacing:

$$h = \sqrt{h_r^2 + h_e^2} \qquad (1)$$

where

h = thickness of required single slab, in inches;
h_r = thickness of resurfacing in inches;
h_e = thickness of existing slab, in inches;

or $$h_r = \sqrt{h^2 - h_e^2} \qquad (2).$$

This is theoretically correct only when the old pavement and the resurfacing are of the same stiffness and act as two independent beams deflecting equally under load, with no bond between them.

Formulas 1 and 2 should be used to design resurfacing if the bond between the old slab and the resurfacing is prevented by the use of a bituminous coating or other method, and if the old slab is structurally sound.

If the old pavement has structural breakage or other defects, their effect can be taken into account by the introduction of the coefficient C, so that formula 2 becomes

$$h_r = \sqrt{h^2 - Ch_e^2} \qquad (3).$$

The Department of the Army, Corps of Engineers, has used the following values for C:

C = 1.0 when the existing pavement is in good condition.
C = 0.75 when the existing pavement has initial joint and corner cracks due to loading, but no progressive cracks.
C = 0.35 when the existing pavement is badly cracked or crushed.

If no special steps are taken to prevent bond of friction between the resurfacing and the old concrete pavement, the two slabs will act to some extent as a unit rather than independently as assumed in the preceding formulas. Thus the thicknesses as computed by formula 3 are greater than those required when there is no separating course between the old slab and the resurfacing.

For these cases the Corps of Engineers has used the formula:

$$h_r = \sqrt{h^{1.87} - Ch_e^2} \qquad (4).$$

Formula 4 is also suggested for use where no widening can be provided so that loads may travel on the edges of the resurfacing.

Jointing of Resurfacing

Joints in the concrete resurfacing should be placed over all joints in the existing pavement. Where transverse joints in the old pavement are in intervals of 60 feet or more, additional joints should be constructed in the resurfacing to reduce the slab lengths of 20 feet or less.

It is not necessary to use the same type of joint in the resurfacing as in the old slab, e.g., expansion joints in the existing pavement may be matched by contraction joints in the resurfacing. Expansion joints in the new slab may be omitted, or constructed in long intervals of 600 feet or more, with intermediate contraction joints.

Unless the old slab is reasonably free from cracking, it is usually desirable to use distributed steel in the resurfacing. If distributed steel was used in the original pavement, and no wide cracks have formed in the slab to indicate that the steel has broken, the area of reinforcement in the resurfacing should be based on the thickness of the resurfacing alone. If the old slab does not contain distributed steel, the area of reinforcement should be based on the combined thickness of the new and old slab.

As in any other paving job, concrete resurfacing sometimes may require ingenuity in design in order to meet special conditions. For example, the curb height on a city street may not permit an adequate thickness at the edge. In such a case, it may be possible to remove the old curb and build a new and/or higher curb integral with the resurfacing, making possible the desired edge thickness. On a wide street, it may be necessary to remove the outer four to six feet of the old slab together with the curb.

Another problem may be encountered with a street of multilane construction so wide that it is not practical to tie all lanes together. In such a case a central traffic separator may be constructed integral with the resurfacing. This will strengthen the pavement near the untied longitudinal joint.

Construction of Concrete Resurfacing

Construction of "thick" concrete resurfacing usually involves no great difficulties. If the old pavement is in unsatisfactory condition at a few locations due to an unstable, pumping subgrade, those areas should be removed. The subgrade may then be corrected by placement of a subbase, and—if necessary—provision of drainage.

● **MINIMUM of 5 ins. of resurfacing concrete was placed over the old pavement. In addition, the pavement was widened by placing 2 ft. of 9-in. thick concrete.**

Large areas of bituminous patches should be removed if the modified formula with $h^{1.87}$ is used for the design; however, it may be less costly to use the formula with h^2 instead. No special efforts to effect bond are recommended, or considered necessary.

If the resurfacing job involves widening as well, forms are placed in the usual manner on the subgrade and beyond the edge of the old slab. On wide streets, it may be necessary to drill holes for form pins in the existing slab. Dowels can be supported on baskets which are anchored with studs placed by powder-actuated guns.

Concrete used for resurfacing should be placed with a minimum slump, since the subgrade will absorb little or no water at all. Where the resurfacing job involves widening, tar paper placed upon the subgrade at the edges of the pavement will prevent water absorption, and concrete of the same consistency can be used throughout.

Distributed steel is placed in the same manner as on normal paving operations, namely, by striking off the concrete at the proper elevation, placing the steel on the fresh concrete, and placing the second layer. Consolidation, finishing and curing operations are also carried out in the same manner as on a normal paving job.

A completed concrete resurfacing job will give a city, county, or state all the benefits of a newly constructed concrete pavement, i.e., long life, low maintenance cost, high usability, and good skid resistance. A large number of concrete resurfacing projects built more than 30 years ago, are still giving satisfactory service under today's heavy traffic. Among present-day projects, a major concrete resurfacing job in the state of Minnesota illustrates a typical problem to which resurfacing provided the ideal answer. It was built in 1955 on an 11.1 mile stretch of U.S. 12 between Hudson, Wisconsin, and St. Paul, Minnesota, which is now a part of the heavy-duty National System of Interstate Highways.

The general condition of the pavement, which was built of 9-7-9 in. concrete in 1928, was good. However, the increasing number and weight of vehicles had rendered it inadequate both in width and thickness for modern traffic, and made construction of a dual-roadway necessary.

In 1954 a 24-ft. wide companion roadway was built alongside the original pavement to provide a four-lane highway. The old pavement now constituted the west bound roadway. To bring it up to modern design standards and to correct pavement defects due to subbase failure, the pavement had to be resurfaced and widened 2 ft. on each side to make it 24 ft. wide.

At 10 scattered locations, where frost had caused trouble in the subgrade, the old concrete pavement was removed and a new frost resistant subbase was placed. Forms were set on each side of the original pavement, to provide for 2 ft. widening. A minimum of 5-in. thickness of resurfacing was placed over the existing pavement, and the widening was built 9 in. thick. Wire mesh was placed 2½ in. from the surface of the new pavement. Both resurfacing and widening were placed in one operation. Upon completion, this resurfacing project transformed U.S. 12 into a four-lane, heavy-duty divided highway incorporating the best in design and paving material.

● **PRIOR to placing the resurfacing layer, a 1:1 grout is scrubbed into the old surface with stiff brooms. This is an essential step in insuring a good bonding.**

Thin Bonded Concrete Resurfacing

Thin bonded concrete resurfacing can be used to restore the surface of pavements that have been damaged by any cause, such as freezing during construction, or scaling of non-air-entrained concrete resulting from application of salts to remove accumulations of snow and ice. Thin bonded resurfacing should not be applied to concrete that is unsound, or structurally inadequate for the conditions of service.

A general rule for the use of thin bonded resurfacing is difficult to make, because each job must be evaluated on the basis of whether the new surface can be placed, jointed and constructed at reasonable cost to give satisfactory service. However, in appraising an old existing pavement, bridge deck, etc., for thin bonded resurfacing, the following are some prerequisites that should be given consideration:

1. The resurfacing must be placed on concrete which is structurally sound below the surface disintegration or scale.

2. Scarification of the pavement to remove surface deterioration should be limited to a maximum of 1 in. and preferably ½ in., except in localized areas.

3. The old pavement surface must be clean, free of all dirt, debris and loose material.

4. Joints in the resurfacing must be directly over the joints in the old pavement and of equal or slightly greater width.

5. Construction lane widths should be limited to about 25 feet.

6. Resurfacing thicknesses should, if possible, be limited to 2 inches. They should never be less than 1-inch thick, except for patching and at ramps where grades have to be met.

7. The concrete mix used in the resurfacing should have physical

properties matching as nearly as possible that of the concrete of the old pavement.

8. Maximum size of coarse aggregate in the resurfacing mix should be limited to ½ the thickness of the resurfacing.

9. Distributed reinforcement should be omitted from resurfacing thicknesses less than 3 inches.

Although it concerned restoration of an air field pavement, the surfacing project carried out in the summer of 1956 at Selfridge Air Force Base, Mt. Clemens, Michigan, well illustrates the construction

● **RECENTLY sawed joints of the newly resurfaced section are shown curing with wet burlap strips. At the left, finishing equipment is working on alternate lane.**

methods required for thin bonded concrete surfacing of any concrete pavement.

The Selfridge project was the first major project undertaken by contract since the method of applying thin bonded concrete resurfacing had been developed in laboratory and field experiments, largely by the Portland Cement Association. Some 46,400 square yards were placed at a total cost of $3.95 per sq. yd., a price that undoubtedly reflects the newness of the process at the time. A reduction in cost up to $1.00 per square yard for projects now being planned is confidently expected, because of development of a larger scarifying machine, growing familiarity with problems involved, such as etching with acid, and the methods developed for forming each construction lane.

The principal defects in the pavement corrected by the resurfacing were surface scaling, ravelling along joints, and surface pop-outs over unsound particles of coarse aggregate.

Steps of Surface Preparation

The first step in preparing the existing surface for resurfacing was removal of all bituminous material from joints, cracks and elsewhere on the pavement. The excessive amount of JFR sealer which had been applied, the hot weather during removal, and the irregularity of the joints were contributing factors to difficulties encountered in joint routing operations. This irregularity also made jointing of the resurfacing more difficult. Jet fuel-resistant sealer was removed from the joints by plowing with an improvised "foot" mounted on the front of a light tractor-loader. Then the bituminous material adjacent to the joints was removed with a scarifying machine.

● **SURFACE of old pavement is scarified prior to placing new concreting.**

General scarification of the pavement surface followed, and was carried out with a fleet of four machines, mounting heads packed with 4-in. drop forged cutters that made a clean cut about 4 in. wide. The edge of the cut was defined by hand brooms. Since failure to define each pass by blowing or brooming reduces the efficiency of each machine and cutting head, a medium sized, self-propelled pick-up broom is essential in this and other dry-clean operations.

With a working unit area scarified, dry swept, and blown, the next step in preparing the old surface was to remove, where necessary, any oil stains. This operation which used a detergent was confined to the five 24-ft. lanes of an old runway. All other lanes of the apron, except two, were fully scarified and needed only spot treatment.

The water soluble detergent was applied to the wetted pavement surface with a hand operated distributor similar to a seeder. It was then scrubbed into the surface with a tow-type sweeper, and the surface flushed with water until it showed a neutral reaction to pH paper. Neutral reaction to pH paper is required, because the detergent, a sodium metasilicate, is highly alkaline, and would otherwise partially neutralize the acid subsequently applied for etching the surface.

An improvement over previous projects was made in handling and applying the acid. The 20° Baume commercial muriatic acid was delivered to the job in bulk by a tank truck equipped with a 12-ft. spreader bar, and an electric pump on the truck supplied the necessary pressure for distribution. A portable generator, towed alongside the tank truck, supplied the power for the pump. One gal. of acid was applied to 100 sq. ft. of the wetted pavement surface.

This treatment left the pavement surface with a sandpaper texture, which is desirable for a good bond. As soon as all visible etching or foaming action ceased, the pavement surface was flushed with water until it showed a neutral reaction to pH paper for the flushing operation. A water tank truck with a minimum capacity of 2,000 gal. is necessary. It must be equipped with a pump of sufficient size to give a flushing pressure through a 1½-in. hose, or through side mounted "cock's comb" nozzles. It is equally essential for other wet-cleaning operations.

(*Continued on page* 142)

Experiments with ODOR CONTROL IN SEWERS

LEVI PRICE,
Township Engineer
and
HAROLD CURRAN,
Supervisor of Public Works
Millburn Township, N. J.

ODORS in sewage lift stations, in sewer lines having flat grades and in force mains have created problems during the summer months in Short Hills, Millburn Township, N. J. To combat this condition we have cleaned the lift stations, flushed low gravity lines and applied chemicals at several points in the system. This paper is a report of our experiences.

During the summer of 1954, Cloroben, a product of the Cloroben Chemical Corp. was used, with excellent results. Complaints were eliminated during the years 1954 and 1955. However, in 1956, we experimented with a different type of chemical having generally similar characteristics. Though application was made in the same manner as with Cloroben, odors were not controlled and the old familiar complaints were again heard.

The recurrence of odor problems in 1956 at the same locations was puzzling. New building construction in the affected areas had been minor. The sewer mains carried substantially the same low flows of previous years. We decided that climatic conditions during this particular summer might be responsible. As counter measures we doubled the amount of chemical being applied at the three dosing stations. We also established a fourth station down-sewer for an additional boost. After a few days we increased the dosage four times in one particularly obstinate station. This method relieved the situation but not to our complete satisfaction. Furthermore, we were concerned about the cost of this procedure.

Fall and winter brought abatement of the odors, and we hoped for more favorable conditions when early spring of 1957 arrived. We commenced application again in early April. It soon became apparent that we were facing an extremely difficult year as a severe drought gripped the entire East.

Despite all efforts which included periodic flushing of low gravity lines and weekly cleaning of lift station wet wells, odor complaints increased and persisted. With no relief in sight, it was decided in mid-July to undertake immediately a systematic survey of the affected areas. Sulfide and pH determinations were made throughout the system. Toward the end of July we had established twelve permanent odor conditions. Total sulfides of 0.3 ppm and a pH below 7.5 invariably spelled objectionable odors along the lines, but always occurring in specific catch basins and lift stations.

To familiarize the crew with the extent of the problem, we drafted a skeleton map of the main sewer lines, lift stations, force mains, sampling and dosing stations. The locations where odors were consistently released were pin-pointed. Copies of this map were carried in the field and marked as part of the record. This resulted in a somewhat clearer picture of the situation than would be obtained otherwise. Not to overlook any possibility we also ordered several drums of Cloroben and decided to compare its effectiveness with the material then being used.

Table 1—Total Sulfide and pH Determinations

	July Average Chlorobenzene 4 ppm		August 1 Cloroben 4 ppm		August 9 Cloroben 4 ppm		August 27 Cloroben 2 ppm		Sept. 30 Cloroben 2 ppm		Oct. 30 No Treatment	
	S	pH	S	pH	S	pH	S	pH	S	pH	S	pH
Passaic R. Area Lift Station	0.1	6.5	0.1	7	0.1	7.5	0.1	7.5	0.1	7.5	0.1	7.5
Canoe Brk. Road Lift Station	0.2	7	0.1	7.5	0	7.5	0	7.5	0.1	7.5	0.2	7.5
Canoe Brk. Road Force main	1.2	7.5	0.5	7.5	0.2	7.5	0.2	7.5	1.2	7.5	2	7.5
Addison Street	1.2	7.5	0.3	7.5	0.3	7.5	0.5	6.5*	1.2	7.5	2	7.5
Keith Drive	1.3	7.5	0.3	7.5	0.3	7.5	0.5	6.5	1.2	7.5	2	7.5
Slayton Lift Station	1.5	7	0.3	7.5	0.3	7.5	0.6	7.5	1.3	7.5	2.5	7.5

**Drop in pH caused by small lateral temporarily obstructed. After flushing and disinfecting with Cloroben, pH returned to neutral.*

The Cloroben claim that a special process was responsible for making the active ingredients available and effective in the suppression of H_2S-producing organisms was to some extent supported by Professor Rolf Eliassen. He, in his paper, "The Effect of Chlorinated Hydrocarbons on Hydrogen Sulfide Production" (*Sewage Works Jour.*, Vol. XXI, No. 3, May 1944), stated: "Since orthodichlorobenzene is insoluble in water, it requires a strong emulsion to achieve the ultimate degree of dispersion required to affect most of the bacteria in the sewage. Therefore, as much attention must be paid to the properties of the emulsion as to the chlorinated hydrocarbon

which is the effective inhibitory agent."

The Collection System

The entire flow from the western half of Millburn is collected in a high level gravity line 3½ miles long which traverses the township from north to south. Eventually it delivers all the waste, purely domestic, into the interceptor of the Joint Meeting Sewerage Authority serving eleven municipalities in the New Jersey greater metropolitan area.

The upper section (2 miles) of the high level gravity line is free of serious odor problems. This section is largely fed by numerous short laterals sustaining a steady flow. Then the volume is doubled in the main, with septic sewage being discharged from an extensive residential area. This addition to the flow, roughly one mgd, has passed through three lift stations and force mains before joining the relatively fresh sewage at Slayton Dr. Another half mile south the line receives its last important contribution. This also is a flow with septic tendencies, delivered by numerous laterals and the Colonial Way lift station serving some 70 homes. From here on, the flow in the high level gravity line is fast and odors mainly produced in the two contributing lateral systems are released in a very exclusive residential section of Short Hills.

During our survey in July, sulfide and pH determinations convinced us that 80 percent of our odor problems originated in the lateral system served by the Slayton Drive lift station which, in itself, was a major source of complaints. Total sulfides averaged 1.5 ppm with a pH of 7.0 in the sewage entering the wet well. But what interested us in particular was that sulfides were being produced at the very beginning of this sewer system two miles east of the lift station and in an area completely void of homes.

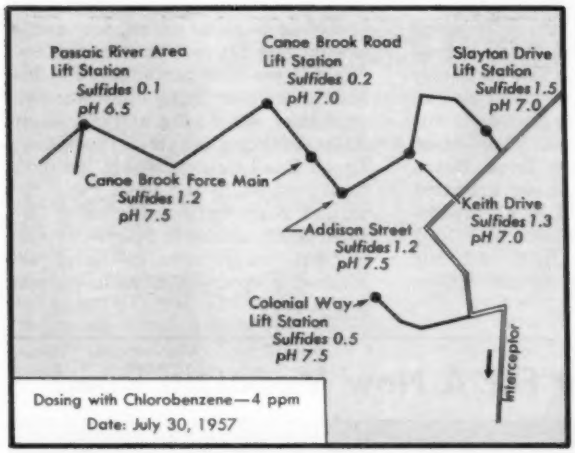
A large suburban department store and a headquarters office for an insurance company are located at this point. The waste from these two establishments is collected in the lift station in the Passaic River area which does not receive any other flow. The insurance company, employing some 800 people, and the department store, when busy, servicing several thousand people keep the lift station in the Passaic River area in action six hours of the day. At night the flow is reduced to a mere trickle, and on week ends it is almost non-existent. There was no way to correct this erratic condition.

Septic Sewage

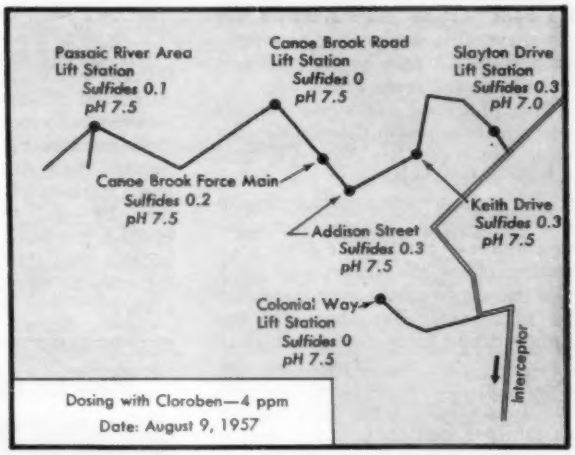
The flow entering from the department store, which includes a large restaurant, has an average pH of 6.5 and total sulfides of 0.1 ppm. From the insurance office, sulfides were negative and the pH 7.5. The wastes enter the wet well where, except during the busy hours of week days, they may remain for hours before the volume reaches the 4,500-gal. mark to start the automatic pump. The waste is then pumped through an eight-inch force main for 1,685 feet, and continues by gravity for half a mile to the Canoe Brook lift station. There are no dwellings along the last mentioned gravity line and little addition to the flow as it enters this second lift station; but sulfides in July had doubled to 0.2 ppm in the line while the pH showed a slight correction to 7.0.

The erratic conditions noticed at the Passaic River area station are repeated at Canoe Brook Road Station where the volume required to start the pump is 7,300 gals. The situation is somewhat relieved by a separate line contributing a small but steady flow of relatively clear water directly into the wet well. Nevertheless, the sewage is again retained for prolonged periods during night and week ends in contrast to its regular discharge every fifteen minutes during business hours. From the Canoe Brook Road wet well the waste is pumped through a 10-inch force main for a distance of 1,800 ft. with total sulfides showing a sharp increase in July from 0.2 ppm to 1.0 ppm. Strangely enough the pH recovers to a neutral 7.5, perhaps through the admixture with the clear drainage water. The flow again continues by gravity and is greatly increased by the contribution of connecting laterals as it enters a well-populated residential section from which we received our first regular odor complaints. In July the pH, after having recovered to 7.5 in the Canoe Brook Road lift station and force main, dropped to 6.5 within five blocks of gravity flow. There was a gradual correction of the pH from this point and for the next half mile to the Slayton Drive lift station. Here, as previously mentioned, the pH was 7.0 while total sulfides had increased to 1.5 ppm.

Early in 1957 a dosing station had been established at the Passaic River area station and a second dosing station at Canoe Brook Road



● **RESULTS when treating sewer system with chlorobenzene. Sulphide content and pH are shown for the various locations.**



● **DIAGRAM shows how sulphides were controlled by the use of 4 ppm of Cloroben. For application methods see text.**

station. Later we located a third dosing station at the Slayton Drive station.

Cloroben Treatment Started

On the first of August the two dosing tanks, one at the Passaic River area station and the other at the Canoe Brook Road station, were charged with respectively 5 and 3 gallons of Cloroben, or a total of 8 gals. which we estimated to be approximately 4 ppm for the entire flow of the western part of Millburn.

Results were achieved faster than anticipated or even hoped for. By mid-afternoon total sulfides in the sewage arriving at Canoe Brook Road had been reduced 50 percent, to 0.1 ppm and the pH was 7.5. This reduction was maintained in the Canoe Brook Road force main where sulfide production likewise showed an immediate 50 percent decrease to 0.5 ppm. At the Slayton Drive lift station sulfide production was lowered from 1.5 ppm to 0.3 ppm and the pH raised from 7.0 to 7.5.

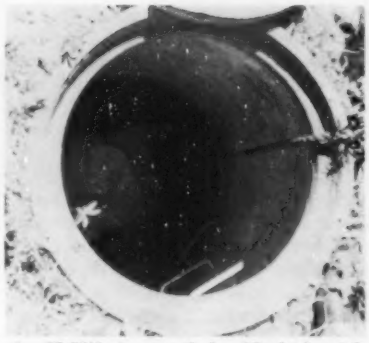
The following week we continued our dosing with Cloroben at the same 4 ppm rate. By August 6, total sulfide determinations at the Canoe Brook station were negative despite the fact that the sulfide concentration intake at the Passaic River area station (from the department store and insurance office) continued at a 0.1 ppm level. The effluent of the Canoe Brook force main meanwhile demonstrated an impressive decrease in sulfide production from the original 1.0 ppm when using chlorinated benzenes to 0.1 ppm.

At the Slayton Drive lift station an inconsistency developed. During the first few days of using Cloroben we had reduced sulfides from 1.5 ppm to 0.3 ppm. Determinations now revealed a slight increase to 0.5 ppm all of which was confusing, considering the reductions obtained in the rest of this lateral system.

Clogged Sewer Located

During the next few days we found that a small sewer half way between Canoe Brook Road and Slayton Drive had clogged. Its sluggish discharge gave a pH of 6.5 and total sulfides of 5.0 ppm. While the volume delivered seemed insignificant, this sewage obviously seeded the main flow. We corrected this problem by manual cleaning and the temporary application of a local shock dose.

Three days later, being satisfied with the overall results and no longer receiving any complaints, we cut our Cloroben application to approximately 2 ppm based on the entire flow. This reduction resulted in a gradual but a corresponding increase in sulfide production. It was rather insignificant, and we were still maintaining full odor control. During the rest of August and early September we made further experiments, arriving at the conclusion that Cloroben applied at the rate of 2.5 ppm to 3.0 ppm in this particular section of Millburn supplied an expedient and economic answer to our problem. Reports from other cities, notably Los Angeles, Long Beach and Oklahoma City, have indicated that 1.4 ppm to 2.0 ppm accomplished the same results. It is our opinion that the erratic flow in our lift stations account for the difference.



● **FLOW in manhole blocked with sand bag to permit longer contact time.**

One experience pointing in that direction was gained at the Colonial Way lift station. The wet well in July was covered with a heavy scum mat and emitted strong sewage odors. Sulfides were 0.5 ppm, the pH 7.0. We changed to Cloroben and in three days the pH was corrected to 7.5 and the scum mat dissolved. Later, application was cut to one quarter with the improved condition maintained. In September we discontinued daily applications in favor of a weekly shock dose of one gallon. The effect of this application lasted a few days when sulfides again were produced.

Though the season was too far advanced to draw definite conclusions, our observation suggested the possibility that regular periodic shock dosing may be sufficient to control H_2S. In this connection, however, we are of the opinion that while Cloroben is effective in correcting odor problems in force mains, low grade sewers and lift stations, its residual effect is not very prolonged. For instance, in late September we discontinued our dosing at the Passaic River area station and the Canoe Brook Road station. Within ten days total sulfides in the force main returned to 1.0 ppm; and in early October total sulfides in this force main without treatment of any kind had reached 2.5 ppm, perhaps its normal production.

Pavement For A New Mountain Road

IN THE photograph above a Flaherty "Spread-Master" power spreader is shown applying ½-inch chips to a shoulder of the new short cut route between Great Falls and Missoula, Mont. When photographed, the "Spread-Master", owned by Hilde Construction Co. of Great Falls, had already completed the double bituminous penetration surface on a 10-mile section of the road. For the shoulder spreading operation only one of the two conveyors is used to transfer material from the truck receiving hopper to the front spreader hopper, a feature which helps control spread of cover material from widths of 6″ to 13′.

Municipal Parking Financed By Special Assessment District

● MINOT'S principal off-street lot holds 80 to 90 cars. Lease agreement with private firm provides for operation on fixed fee plus percentage of gross.

R. B. RIDDLE, City Manager, Joplin, Missouri, formerly City Manager, Minot, North Dakota

A CITY of 22,000 people in 1952, Minot, N. Dak., is primarily a trade territory serving a number of smaller communities and a great agricultural area. The area served comprises approximately 22,500 square miles. Minot has grown to a community of 27,500 and expects to reach 45,000 by 1965. This growth can be attributed in large measure to the USAF Jet Interceptor Base now under construction.

Traffic continues to be a problem for every city, but the most serious problem concerning traffic, is parking. The average citizen cannot get away from the fact that he would like to park by, or near to, his destination. It is more difficult to find a convenient parking place, that will fill this need, than it is to drive in heavy traffic.

Too much emphasis has been placed on the movement of traffic in our downtown areas without due consideration also being given to parking. Parking as a part of our transportation system has not been fully appreciated, and therefore is somewhat behind in development to its full utilization. Parking facilities in nearly every city are inadequate.

Since 1946 the number of cars on streets and highways in the United States has increased more than 50 percent and it has been estimated that it will increase 50 percent or more in the next seven years. In 1956, 14,000 more vehicles were registered in the State of North Dakota than in 1954. Ward County registered 18,362 vehicles in 1956 and approximately 19,500 in 1957. As the number of cars increase the use of mass transportation declines and as the number of "one man per car" drivers increase we add to our parking problem as well as increasing highway congestion.

Many people are prone to say, "in smaller communities, 10,000 to 50,000 as compared to large metropolitan areas the parking problem isn't as great". Just the reverse is true, because as the size of the City decreases the dependence on cars increases. The Automobile Manufacturers Association says that 85 percent of the people in towns under 50,000 travel by passenger cars while in cities over 250,000 this drops to 60 percent.

Methods of Financing

The parking problem has been handled in different manners by different cities, but primarily it has been taken care of by private capital, municipal ownership and the tax dollar, or a combination of the two. Methods of financing municipal parking facilities have been limited to about three common practices. These are: 1) Revenue bonds; 2) general obligation bonds; and special assessment improvement districts.

The City elected to enter the program on a special assessment improvement district basis. A loop area was established, comprising about 18 blocks in the business district, to form the special assessment district. Estimates were made by the City Engineer, Paul Hays, for completion of the proposed areas to establish parking facilities.

The principal facility is the property located at 2nd Avenue and 1st Street S. W., 140 ft. by 150 ft. It is anticipated that the balance of this half block will be purchased. The other property is a small triangular lot located at the north end of Main Street on the west side and will park 16 cars.

The principal site cost $105,000 and the triangular site cost $10,000. To place the sites in operative condition for flat surface operation, an estimated additional $25,000 was spent for paving, lighting, driveways, etc. The principal site will park 80 to 90 cars.

A lease agreement has been entered into with a private firm for the operation of the principal site. The lease agreement provides a fixed fee for the 1st $16,000 gross; 15 percent of the gross from $16,000 to $20,000; and 40 percent of the gross over $20,000. Monies derived from the lease and rental of the proposed areas will be applied against the special assessment district.

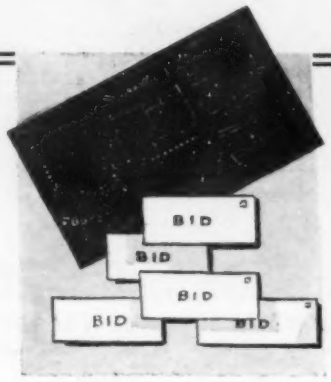
CONTRACTORS

Must be Qualified to Perform Municipal Work ——

L. R. KUIPER,
Coordinator of Public Works,
Aurora, Colorado

LYING directly east of Denver, the City of Aurora, Colo., was incorporated many years ago. Its tremendous growth since 1950 has necessitated a great deal of new construction to provide the normal services required for any city. According to the 1950 census, the population of Aurora was 11,421. An estimate of the population in 1957 is 36,000. During this seven year period, it has been necessary to build a new sewage treatment plant; a new municipal building; many miles of water transmission and distribution lines; sewer lines; and streets; as well as a recently completed swimming pool. A city growing at this rate cannot hope to maintain sufficient labor and equipment forces to do its own work and, therefore, practically all the development work necessitated by this population increase has been by contract.

In order to determine a contractor's capability for doing the particular job for which he is submitting a bid, and doing it within the time limit stated, a contractor is required to furnish, together with his bid, a financial statement or a credit rating from a recognized credit agency; a statement of experience during the past five years on jobs of a similar nature and magnitude; references; and a list of equipment with which he intends to do the job. Financial statements, credit ratings, experience and references submitted by the contractor are always checked in detail. Wherever possible, consulting engineers, resident engineers and/or inspection personnel on previous jobs are contacted to determine their estimate of the contractor as regards quality of workmanship, administration, and public relations maintained by the contractor.



A bid bond either in the form of a certified check or a bond furnished by reliable surety company in an amount equal to 5 percent of the bid is required to accompany all bids. A performance bond is required in an amount equal to 100 percent of the contract before the contract is signed.

From the aforementioned information a determination is made as to which is the best bid and that bid is accepted. The best bid is not in all cases the lowest bid.

The city reserves the right to approve or disapprove supervisory personnel placed on the job and, in the event such supervisory personnel does not prove to be competent, to require their replacement by the contractor. Skilled craftsmen are required to have passed examinations conducted by their appropriate trade organizations, and are required to have continuous approval by the project engineer. They are subject to replacement, at the direction of the project engineer, should they prove to be incompetent.

Line and grade stakes are provided at intervals which the accuracy of the job requires. As a general rule, line and grade stakes for curb and gutter and for sewer lines are provided at 25-ft. intervals. Grade stakes for street crowns (where curb and gutter are in place on either side of the street) and water lines are provided at intervals of from 50 to 100 ft. depending on the topography. In the case of a building complex, such as the sewage disposal plant or a swimming pool, a reference bench mark is provided at the location requested by the contractor, generally located in such a position that elevations for all of the elements of the complex may be shot from this single location. A detailed plot plan is furnished and a base reference line staked on the ground.

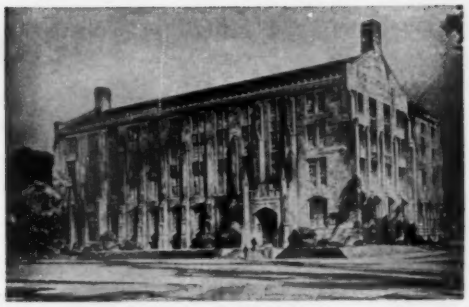
Estimates

Progress estimates are normally made monthly. In most cases, the estimate is drawn up by the project engineer and submitted to the contractor for approval before the payment is made. In addition to the time limitation on the payment of estimates a limitation on the amount of an estimate is established as the criteria for the payment. For example, in a recent street improvement district, payment estimates were provided for on a monthly basis or upon the completion of $50,000 worth of work, provided, however, that estimates would not be made more frequently than once a month. In this case, the contractor was paid in bonds rather than in cash, and this limitation was imposed in order to regulate the issuance of the bonds.

Normally, 15 percent of the amount of each estimate is retained pending completion of the entire contract. No elements of any contract are accepted on a piece-meal basis. The only acceptance is at the completion of the entire job, at which time the entire contract is accepted. This, of course, is to place the burden on the contractor of maintaining completed structures in good condition, during subsequent construction operations.

Maintenance of the standards for contractors set forth above has resulted in good quality work which is done in good time and with good public relations maintained. Work is done within the contract time, thus enabling planned usage of the facilities constructed to proceed according to plan.

News BULLETINS



AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

Ellenson Appoints Committees

Chicago, Ill. — APWA President Sol Ellenson recently announced appointments to five of the Association's important committees. Named to serve on the Engineering News-Record Air-To-Education Award Committee for a three year term ending 31 December 1960, is August Zentgraf, Chief Engineer, Department of Public Works, Newark, N. J. Henry D. Harral, Executive Deputy Secretary, Pennsylvania Department of Highways, Harrisburg, will serve as Chairman this year, and John G. Thompson, City Engineer of Madison, Wisc., continues as the third member of the committee.

Nominating Committee

The task of submitting a slate of officers and directors for 1958-59 to the members of APWA was assigned to Robert L. Anderson, Superintendent of Public Works, Winnetka, Ill., Chairman of the Committee; Edward P. Decher, Secretary and Purchasing Agent, Joint Sewer Commissioner, Newark, N. J.; R. L. Eberline, Asst. City Engineer of Albuquerque, N. Mex.; Timothy J. O'Leary, Gen. Supt., Sanitary Div., Department of Public Works, Boston, Mass.; and William A. Xanten, Supt., Division of Sanitation, Washington, D. C. Officers and directors to be elected in accordance with the revised Constitution adopted in January 1956, will be the President and Vice-President, and Directors of Regions 5, 8, and 9. Members may submit names of candidates directly to the Nominating Committee for its consideration. This should be done before June 1, the date set for the report of the Committee.

S. A. Greeley Service Award Committee

The Samuel A. Greeley Service Award Committee will be headed by Samuel A. Baxter, Water Commissioner of Philadelphia, Pa., and serving with Mr. Baxter will be Carl Schneider, Consulting Engineer of New Orleans, La., and John S. Flockhart, formerly Chief Engineer of the Newark, N. J., Dept. of Public Works, and now retired. Eligibility requirements for the award are that the candidate must have served his governmental unit continuously for thirty years, and that he must have been a member of APWA at least five years. Questionnaires are being mailed to all members with an affiliation date prior to and including 1953.

Resolutions Committee

Appointments to the Resolutions Committee named Henry Liebman, Director of Operations, Dept. of Sanitation, New York City, Chairman. The other three members designated are: Arthur Brokaw, City Engineer of East Orange, N. J.; George Elliott, Jr., Senior Mechanical Engr., Bureau of Mechanical-Electrical Service, Baltimore, Md.; and J. Grady Phelps, Supt., Div. of Municipal Wastes, Dept. of Public Service, Miami, Florida. The APWA president serves as an ex-officio member of the committee. All resolutions that are to be presented at the annual business meeting to be held in Kansas City this year, must first be referred to the Resolutions Committee. No action can be taken on a resolution without a previous report on it by this Committee. Proposed resolutions may be submitted to any member of the Resolutions Committee.

C. W. Nichols Award Committee

Appointed to serve a three-year term on the Charles Walter Nichols Award Committee was Hugo G. Erickson, City Engineer of Minneapolis, Minn. Warren A. Coolidge, Consulting Engineer of Nashville, Tenn., will serve as Chairman of the 1958 Committee, and Morris M. Cohn, Editor of Wastes Engineering, New York City, continues as the third member of the Committee.

Nominations are now being accepted for the 1958 Award, which is annually presented to a member of the Association in recognition of outstanding and meritorious achievement in the broad field of sanitation, including refuse collection and disposal, street sanitation, sewerage and sewage treatment and water purification and distribution.

The award consists of an honorarium of $500 and a scroll describing the achievement. Any member may nominate a candidate for the award by simply writing a letter to the Nichols Award Committee, in care of the APWA in Chicago. The letter should briefly describe the achievement. Further information will thereafter be requested from the nominees of the award. All candidates must be active members of the American Public Works Association and engaged in full-time employment by a municipal government.

OFFICERS: Sol Ellenson, Newport News, Va., *President;* Wm. D. Hurst, Winnipeg, Manitoba, Canada, *Vice President.* REGIONAL DIRECTORS: (term ending 1958) Jean L. Vincenz, San Diego, Calif.; Leo Flotron, Dayton, Ohio; Roy W. McLeese, Salt Lake City, Utah; (term ending 1959) Albert G. Wyler, New Orleans, La.; Edward J. Booth, Bismarck, N. D.; Frederick Crane, Buffalo, N. Y.; (term ending 1960) Charles W. Cooke, Hartford, Conn.; R. S. Hopson, Richmond, Va.; H. H. Hester, Fort Worth, Texas. *Immediate Past President,* Robert Anderson, Winnetka, Ill. Donald F. Herrick, *Executive Director*

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MANUFACTURERS OF ADVANCED DESIGN CONCRETE GUNNING, MIXING, GROUTING AND SANDBLASTING EQUIPMENT.

Peebles Elected President of North Carolina Chapter

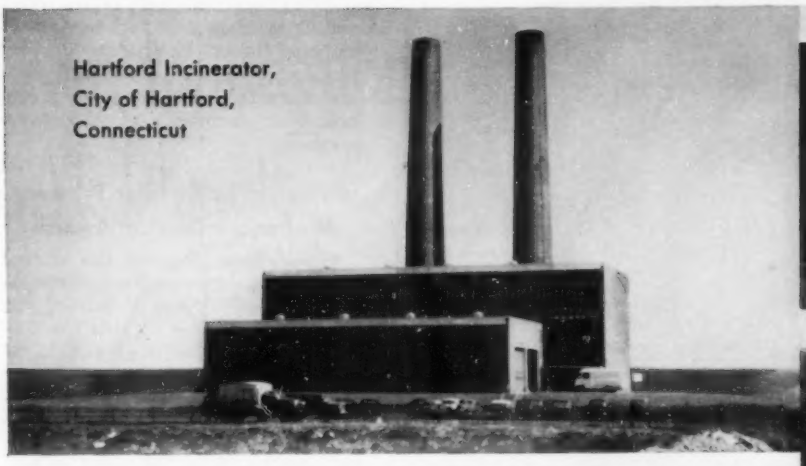
Raleigh, N. C.—The North Carolina Chapter held its second annual meeting in Raleigh in conjunction with the Fourth Annual Municipal Public Works Conference sponsored by the North Carolina League of Municipalities and North Carolina State College.

This conference, held on February 7 and 8, included a panel discussion on state highway and municipal cooperation. led by W. F. Babcock, Director of Highways for North Carolina. The afternoon session of the first day was devoted to a discussion of public works equipment including purchasing and rental of equipment and the operation and routine maintenance of equipment. The highlight of the program was the banquet held on Friday evening which was presided over by H. L. Medford, Director of Public Works, Greensboro. Robert S. Hopson, Director of Public Works, Richmond, Va., and Regional Director of the APWA was principal speaker. Following the banquet, the chapter held its annual business meeting and election of officers. Vernon Peebles, City Engineer of Raleigh was named President; H. L. Medford, Director of Public Works of Greensboro, was named Vice-President; and re-elected as Secretary-Treasurer was S. Leigh Wilson, Assistant Executive Director, North Carolina League of Municipalities. Elected to the Board of Directors were: Robert F. Coleman, Jr., City Engineer, Wilmington; T. R. Morris, Jr., City Engineer, Hickory; and W. F. Babcock, Director of Highways for the State of North Carolina.

North Dakota and Manitoba Members Confer at Grand Forks Meeting

Grand Forks, N. D.—The North Dakota Chapter of the APWA held its second annual meeting in the Student Union Building at the University of North Dakota on February 21, 1958. This meeting preceded the Annual Conference of the League of North Dakota Municipalities which was held at the same location on February 22. A total of 35 members and guests were in attendance including a sizable turnout from the Manitoba Chapter in the Winnipeg area.

The following topics were discussed: "Sub-Division Planning" by George Toman, Consulting Engineer of Mandan; "Sewage Lagoons" by Willis Van Heuvelen, Director of



Hartford Incinerator,
City of Hartford,
Connecticut

(1) Hartford's Fitchburg Chipper

(2) Fitchburg Chipper in action

Modern Hartford disposal plant uses FITCHBURG CHIPPER

Hartford's new municipal incinerator is used to dispose of more than 400,000 pounds of waste every day. The large picture above shows this efficient, attractive plant—one of the most modern in the nation.

An important part of Hartford's up-to-date disposal program is their portable Fitchburg Chipper, which cleans up disposal jobs the incinerator cannot handle, and goes out on location for road use.

Hartford had these problems:

• *Banana Stalk Disposal* • *Brush Disposal on New Roads*
• *Christmas Tree Disposal* • *Road Clearance from Storm Damage*

How a Fitchburg Chipper solves these problems:

Joseph J. Coffey, Superintendent of the Hartford Incinerator, tells you in his own words how Hartford solves these problems: BANANA STALKS: "We chip 2 to 4 tons of banana stalks each week. These stalks will not burn regardless of heat in the furnaces, and we had to dump them until the Fitchburg Chipper went on duty." CHRISTMAS TREES: "During the post-Christmas season we receive many Christmas trees which we can now get rid of without the trouble of watching for burnt-down spike-like stubs which cause much trouble with the incinerator equipment."

BRUSH DISPOSAL: "Our Highway Division has used our Fitchburg Chipper to clean up the brush and branches along newly developed road areas. By chipping brush, the city saves in use of both manpower and trucking costs." ROAD CLEARANCE: "If we get hit again by hurricanes or bad wind storms, we now have an excellent piece of equipment that will enable us to readily open up the streets for emergency traffic by reducing the fallen branches to chips."

As to maintenance, Mr. Coffey says: "Our Fitchburg Chipper will pay for itself in a very short time. Maintenance, so far, is just keeping it supplied with gasoline and fully lubricated. It is easy to handle, easy to store, and very easy to use."

Get the facts! **Mail coupon for big, FREE, colorful booklet.** Specifications, operating data, explanation of exclusive Fitchburg Safety Spring, actual letters from users.

FITCHBURG ENGINEERING CORPORATION

Read what leading Fitchburg users say

LINE CLEARANCE

The Shade Tree Service Company, Webster Groves, Mo.: "Our figures show that production has been increased by a good 25% with the use of the Fitchburg Chipper. One man can operate the chipper with ease. He alone can handle as much, and more, brush in the same length of time as could two men loading brush on a platform body."

POWER COMPANY

Rockland Light and Power Company, Nyack, N. Y.: "Our men have been particularly pleased with their Fitchburg Chippers. They are rugged and reliable and the convenience of flexible, yet instant brush disposal has the advantage of promoting good public relations and still gives us efficiency."

NEW FREE BOOK
"Chip Dollars From Your Overhead"

Fitchburg Engineering Corporation
Fitchburg, Mass., Dept. PW-48

Send my Free Chipper Booklet.

Name_____

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(Position or Company)

Address_____

City_____ State_____

● **MILTON ROSEN, Commissioner of Public Utilities of St. Paul, Minn., spoke on the future of the Federal-Aid highway program at the Philadelphia APWA meeting.**

Public Health, North Dakota State Health Department; "Material Purchase and Equipment Rental", Vern Fahy, Director of Public Works, Minot; "City Street Planning", C. J. Crawford, Planning Survey Engineer, North Dakota State Highway Department; "Garbage Collection and Disposal", John Kleven, Supt. of Streets and Sanitation, Grand Forks; and "Low Cost Paving" by C. M. Hagen, Supt. of Streets, Oakes, North Dakota.

William Hurst, City Engineer, Winnipeg, Manitoba, and Vice President of the APWA was guest speaker at the noon luncheon. John Kleven was elected President of the chapter at its annual business meeting. W. B. Lukins, Assistant City Engineer, Bismarck, N. D., was elected Vice President and Vern Fahy was named Secretary-Treasurer. Others elected to the Executive Committee were: Harold Stenseth, City Engineer, Devils Lake; and C. M. Hagen, Superintendent of Streets, Oakes. Herb Arnold, City Engineer, Williston, and Erik Peterson, City Engineer, Jamestown, are hold-over members of the committee.

Philadelphia Chapter Presents Meritorious Service Awards

Philadelphia, Pa.—At the annual dinner of the Metropolitan Philadelphia Chapter, held February 27, meritorious service awards for distinguished service in the field of municipal engineering and public works administration were presented to Thomas Baldwin, chief of the Automotive Services Division of the Philadelphia Department of Public Property, and Ernest R. Brooks, Surveys and Plans Engineer in the Bureau of Surveys and Design of the City's Department of Streets. Presentation of the awards was made by City Managing Director Donald C. Wagner.

Baldwin was cited for outstanding service during his 35 years with the city and for his role in developing the city's mobile communications system which has proven invaluable during fire and other emergencies. Brooks was honored for 41 years of service to the city and for his direc-

FEMALE DIE LOCKED IN SHOE

MALE DIE LOCKED IN SHOE

Backed by over 40 years of sign manufacturing experience

Why DEEP Embossing Gives Motorists Greater Protection!

The embossing process upraises letters to catch and reflect light, presenting three-dimensional legibility. Such signs are easier to read at greater distances than flat-painted, two-dimensional letters . . . giving motorists more reaction time.

In strictest conformance to U.S. Sign Standards, Lyle's *deep embossing* with perfect dies provides sharper, clearer and more accurately defined letters and symbols. There's no chance for variation—perfectly proportioned dies turn out uniformly perfect letters *every time!*

What's more, in adding extra legibility, Lyle's *deep embossing* increases strength and rigidity of signs in much the same way that corrugating does to other metal products.

At left you see unretouched photos of male and female dies for a Lyle "Yield Right of Way" Sign. You can see from the height of one and the depth of the other that embossing will be *deep*. (Letters stand out in bold relief from the sign background—making even an unpainted sign highly legible without benefit of contrasting enamels.) This *deep embossing* is just one more reason why you'll know you're getting the best when you buy Lyle Signs!

Write today for your copy of the Lyle 36-page, fully-illustrated Sign Manual, No. B-55.

Lyle **SIGNS, INC.**
2720 University Avenue S.E.
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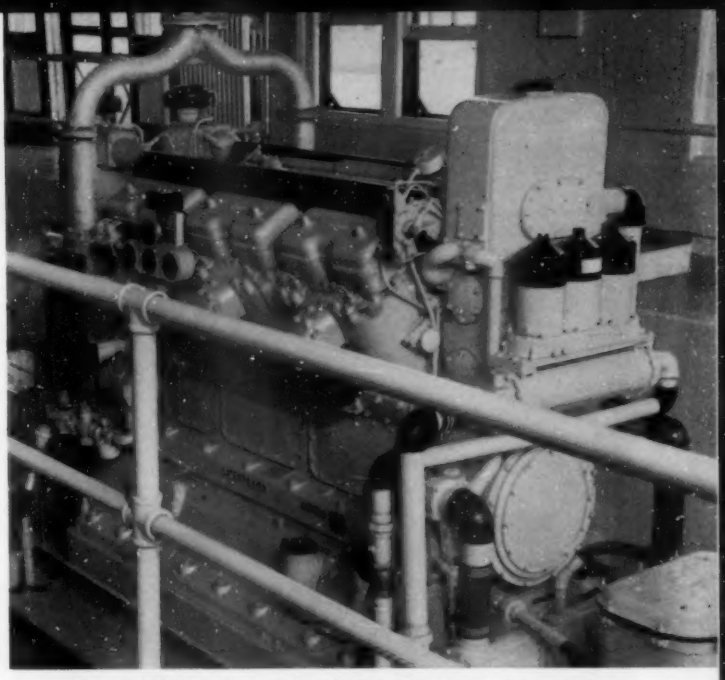
From foundation up, CAT Diesels are modern heavy-duty engines!



City of Wildwood Pumping Station, Rio Grande, New Jersey, relies on this Cat Engine (327 HP output) to furnish all power for water pumpage. The station serves Wildwood, Wildwood Crest, Rio Grande and adjacent communities. The Caterpillar Engine pumps from 5 to 7 million gallons rate of water per 20-hour day, 7 days a week, during the summer.

In more than a quarter century of diesel leadership, Caterpillar has pioneered advance after major advance into its great engines. From foundation up, they incorporate the latest developments of design and manufacturing techniques. As a result, on installation after installation, they have established outstanding records for economy, dependability and long life. Cat Engines are available up to 650 HP (maximum output capacity)—Electric Sets up to 350 KW (continuous duty). They are honestly rated and certified for capacity. Let your Caterpillar Dealer, a power expert, help you select the unit that meets your needs most economically and efficiently!

Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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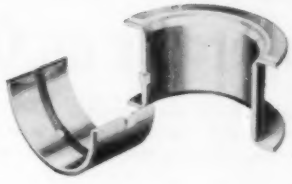
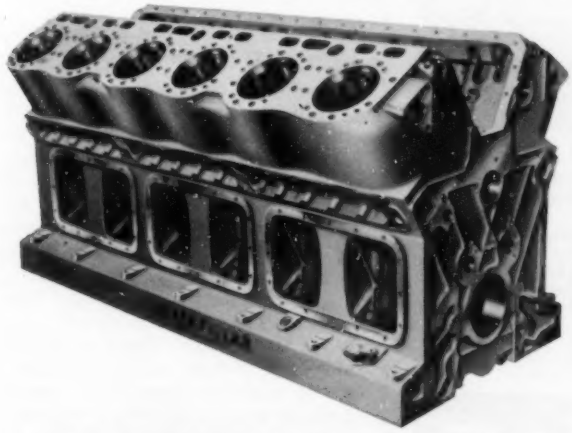
ENGINE POWER BY CATERPILLAR

Heavy-duty pistons. Pistons in Caterpillar Engines combine the light weight of aluminum, the durability of cast iron, the heat resistance of stainless steel and the wear resistance of chromium. All add up to savings for you through a long life of efficient operation with low maintenance costs.



Steel-backed bearings. Steel-backed aluminum bearings are the finest available. Proof: Many Cat Engines have operated for more than 20,000 hours and are still using their original bearings. Chief reason for their long life is their ability to resist acids normally found in engine crankcases.



A firm foundation. Strong, rigid support for all parts of Caterpillar Engines is provided by a unit-cast crankcase and cylinder block. Internal walls give extra support for the bearings and add rigidity to the block. Careful control, modern processing and rigid inspection in Caterpillar's own foundry insure a perfect foundation for every Cat Engine.

Dept. PW4, Engine Division
CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.

Send me more information about Caterpillar Diesel Engines. I have checked the proper box to guide your selection of material.

☐ I would like detailed information, as I may be in the market for a Cat Diesel Engine or Electric Set. I understand that I am under no obligation.

☐ I am interested in learning more about these units.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

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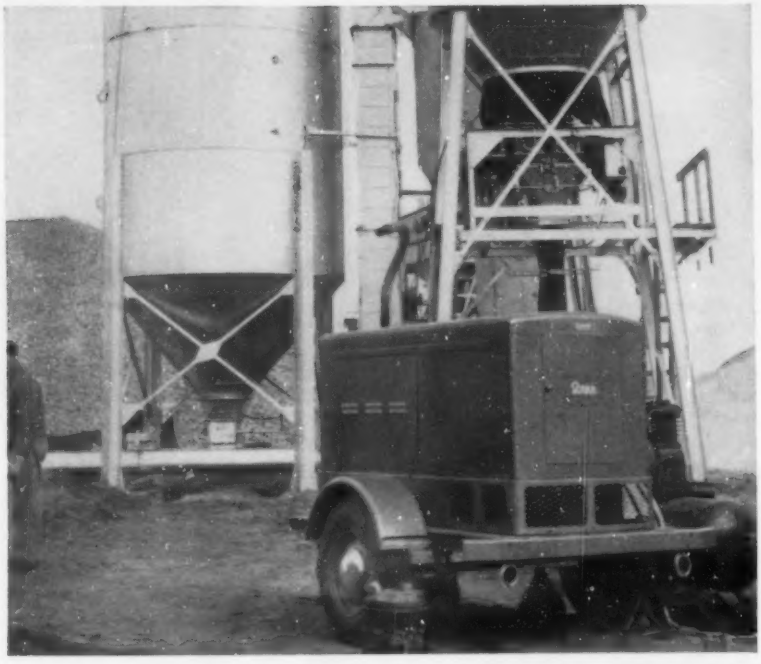
NEWS

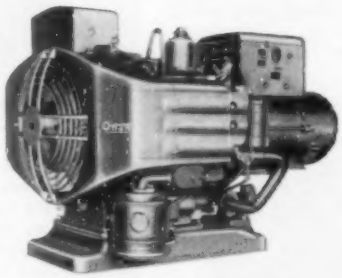


Remote-site bulk cement plant operates on Onan electric power

35KW Onan Plant supplies electricity for one 15 H.P., one 5 H.P., and two 2 H.P. motors; vibrator, controls, welder and lights

It's a completely electrified operation . . . even to electric lights in the mobile office nearby . . . yet this bulk cement plant is far distant from the utility highline. The Onan heavy-duty electric plant, powered by an 8-cylinder, water-cooled industrial gasoline engine, runs continuously during working hours with only a minimum of attention. Has capacity to operate miscellaneous lights, tools, motors and communications, too.

Where efficiency demands that an operation like this one be located close to the job site and where utility power is not available, a mobile Onan Electric Plant is the answer.



Onan Diesel Electric Plants cut floodlighting costs

Operate on low-cost Diesel fuel, readily available on construction job sites. Electric starting. 115 or 230 volts, 60-cycle. Two-cylinder model, 5 KW. Single-cylinder, 3 KW.

Other A.C. models: 500 to 75,000 watts. Also D.C. and Battery Charging units

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ELECTRIC PLANTS • AIR-COOLED ENGINES • GENERATORS • KAB KOOLER

● **MERITORIOUS service award was presented to Thomas Baldwin by Streets Commissioner David M. Smallwood (right) president of the Metropolitan Philadelphia APWA Chapter.**

tion of intricate and difficult engineering phases of the Penn Center development, including the underground street system.

Milton Rosen, Commissioner of Public Utilities, St. Paul, Minn., was the principal speaker at the dinner, which was attended by 500 persons. Council President James H. J. Tate also spoke. George C. Lowe, assistant director of public relations for the Atlantic Refining Company was toastmaster. David M. Smallwood, Commissioner of Streets and president of the local chapter presided.

• • •

Concrete Resurfacing

(*Continued from page* 131)

The foregoing surface preparation steps have been described in chronological order. Any one or several of these operations, as well as paving, are carried out at the same time, and properly scheduled for good production for a project of this size.

Forms

Especially designed wood forms were used along each edge of every other lane at Selfridge Field. Paving of the remaining (fill-in) lanes, representing approximately half of the pavement area, required no forms. The side forms were made from 2 x 8-in. red fir planks 14 ft. long, with their surface dressed down to 1¼ in. thickness. The wood forms were bolted down firmly by lag screws. These were set into lead inserts in holes drilled in the concrete about 5 ft. apart. Drilling was done with electrically driven star drills.

Immediately prior to placing concrete, a 1:1 grout was applied to the old pavement surface. It was

'Our third Cleveland -based on 15 years of dependable performance'

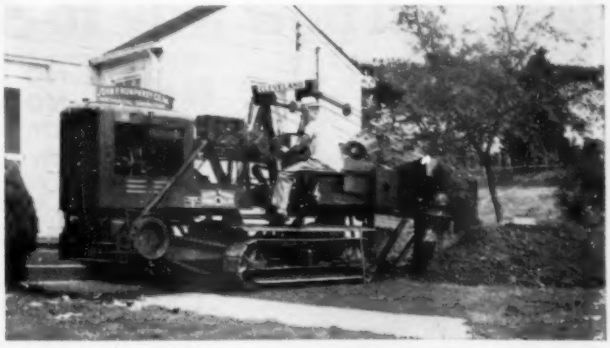
Still in good working order, the Cleveland trencher traded-in by John F. Humphrey Co. of Knoxville, Tenn. on the purchase of a new Cleveland 95 several months ago had been in steady use since 1942. "The purchase of our newest Cleveland—our third—was based on the 15 years of dependable, profitable performance delivered by our first Cleveland," says C. E. Hankins, Jr., vice president of the firm.

Shown cutting an 80-foot service line for 4-inch pipe is Humphrey's newest "95."

The firm is able to schedule more such jobs daily because the Cleveland's fast, safe truck-portability and its wide range of more than 30 usable digging speeds make it fast *to* the job and fast *on* the job.

Long-lived dependability like this is a Cleveland characteristic—one that makes your original investment pay dividends over a long, busy working life. Get complete information from *your* distributor now.

"There's nothing like a Cleveland for trenching."



Good Everywhere

The CLEVELAND TRENCHER Co.

20100 St. Clair Avenue • Cleveland 17, Ohio

mixed to a heavy paint consistency in a paddle type mixer, carried to the pavement area, and scrubbed into the damp—but not wet—surface with rattan stable brooms. A coating about 1/16 in. thick was left on the surface. Excess grout in longitudinal and transverse joints was redistributed with a warehouse broom.

Concrete for paving was obtained from a local ready-mix dealer, and delivered to the site by transit mixers. Two mixers placed the concrete simultaneously on opposite sides of a 20-ft. paving lane. Each mixer carried 5 to 6 cu. yd. of concrete, containing ½ in. maximum size crushed dolemite, 60 percent by weight of natural sand, and 7½ bags of portland cement per cu. yd. Mixing water was added to give a net water content of 5 to 5.1 gal. per sack of cement, and a slump of from 4 to 5 in.

Preceded by moderate hand spreading, the concrete was spread during the first pass of a two-screed, self-propelled finishing machine. A second pass struck and consolidated the concrete to final grade. The finishing machine was equipped with off-set rubber-tired wheels which travelled on the old pavement outside the wooden side boards. This method proved satisfactory, inasmuch as the wood side forms supported only the buoyant weight of the two screeds.

Next, the pavement surface was trued by long-handled scraping straight edges and floats. Final surface texture was achieved with a burlap drag. The resurfacing was cured with a white pigmented curing compound, applied through the hand operated nozzle of a power operated pump. This method of curing, because it could be applied early, prevented rapid loss of water and simplified subsequent joint sawing operations.

"Thin Layer" Joints

In thin bonded concrete resurfacing, it is important that all joints in the original pavement be reproduced in the resurfacing. Longitudinal and transverse expansion joints were formed in place by using wood strips, which were placed in the joint crevice of the old pavement. These strips marked the position of the expansion joints and provided an expansion space in the resurfacing equal to or greater than the space remaining in the basal concrete.

Transverse contraction joints were sawed with abrasive-type blades. Intermediate contraction joints were sawed through the entire depth of the finished resurfacing directly above the old contraction joints. A composition blade in a gasoline operated rig was used in cutting these joints. Exact locations of the old joints were marked on the forms and adjacent pavement and transferred to the finished surface by means of a wire cable attached to nails in the side forms and stretched over the concrete. Sawing had to be done early, in order to prevent precracking over joint locations. It was done from 5 to 12 hours after the concrete was placed, depending on temperature and hardening conditions.

To check the thickness of the resurfacing, and to provide specimens for testing the degree of bond between the resurfacing and the basal pavement, cores were drilled. The resurfacing layer is easily distinguished from the basal concrete.

In determining the bond, the cores are bedded horizontally in a saddle which rests on the testing machine base. The interface between the old and new pavement is placed flush with one edge of the saddle. A saddle propelled downward by the travelling head of the testing machine engages the resur-

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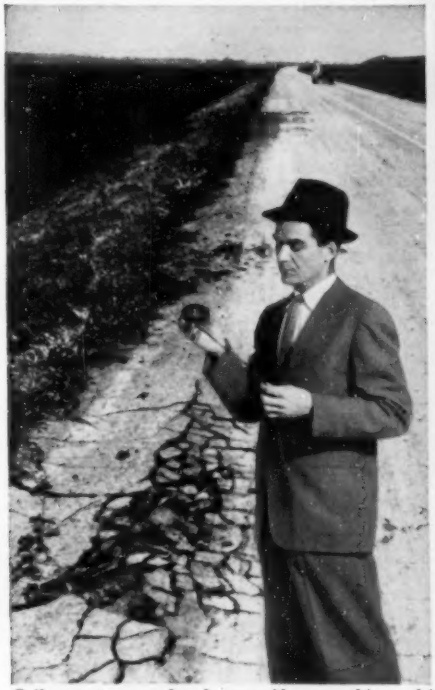
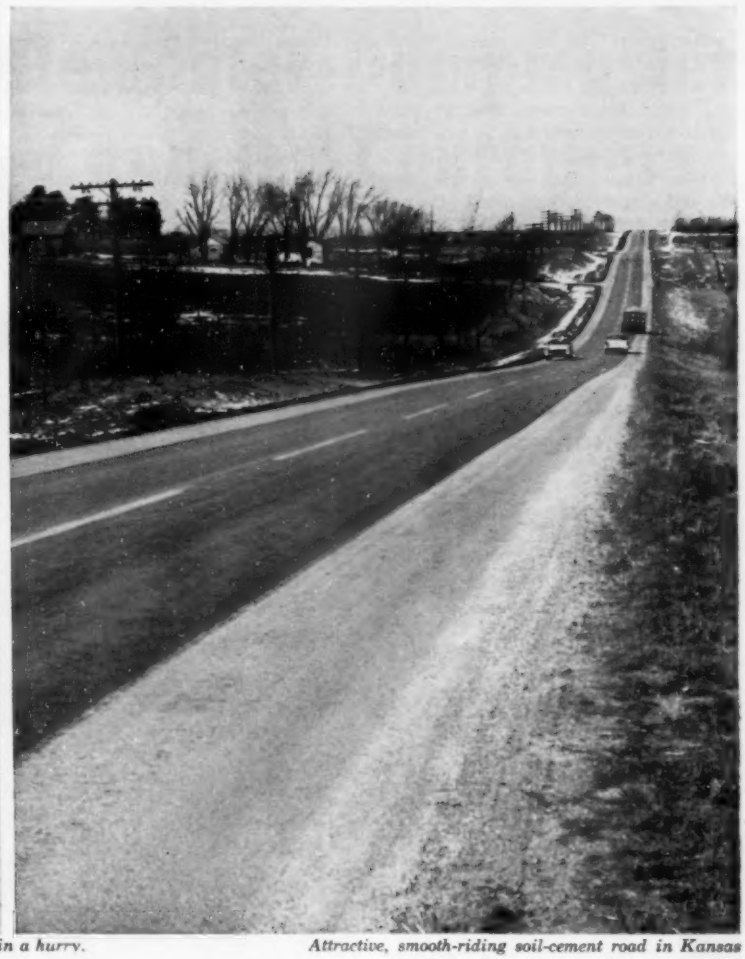


Soil-cement can end upkeep problems on this road in a hurry.



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facing layer. The load measures the direct shear strength of the bonded layer.

These tests showed that in most cases shear failure was in the basal concrete rather than at the interface between the resurfacing and the old concrete. The average shear strength for 17 cores was 310 lbs. per square inch.

Proved Practical

Preceding the Selfridge Airbase resurfacing project, a number of larger projects involving the use of thin bonded resurfacing had been successfully completed. Five of these, with thicknesses varying from 1 to 3 in., were built in 1954 and 1955. These included a badly salt-scaled section of eastbound lanes of the original section of the Pennsylvania Turnpike, 780 ft. long; about 1,550 ft. of old, 18-ft. concrete pavement on U.S. 30 at West Burlington, Iowa, which also needed widening; and a section of a 25-ft. lane of the concrete apron at Little Rock Air Force Base, Arkansas, 575 ft. long, which had been frozen immediately after placing. Also, bonded resurfacing was used to correct unsatisfactory riding qualities of twin bridges on the Ohio Turnpike, and on about 2,000 ft. of a 12-ft. wide slab at Georgetown, Delaware, used for high-speed testing of aircraft arresting gear. All of these projects were completed successfully. They have shown that under proper construction procedures, thin concrete resurfacing can be bonded to old pavement to restore riding qualities in those rare instances where surfaces have become rough. Quality concrete placed on a well-prepared surface will ensure the satisfactory performance of thin bonded concrete resurfacing, and the long service life, heat-resistance, light reflectance, skid-resistance and other qualities which make concrete necessary or desirable.

Editor's Note: The foregoing article is gratefully acknowledged as a contribution of the Portland Cement Association, which furnished this material at our specific request.

• • •

Garden State Parkway Financial Report

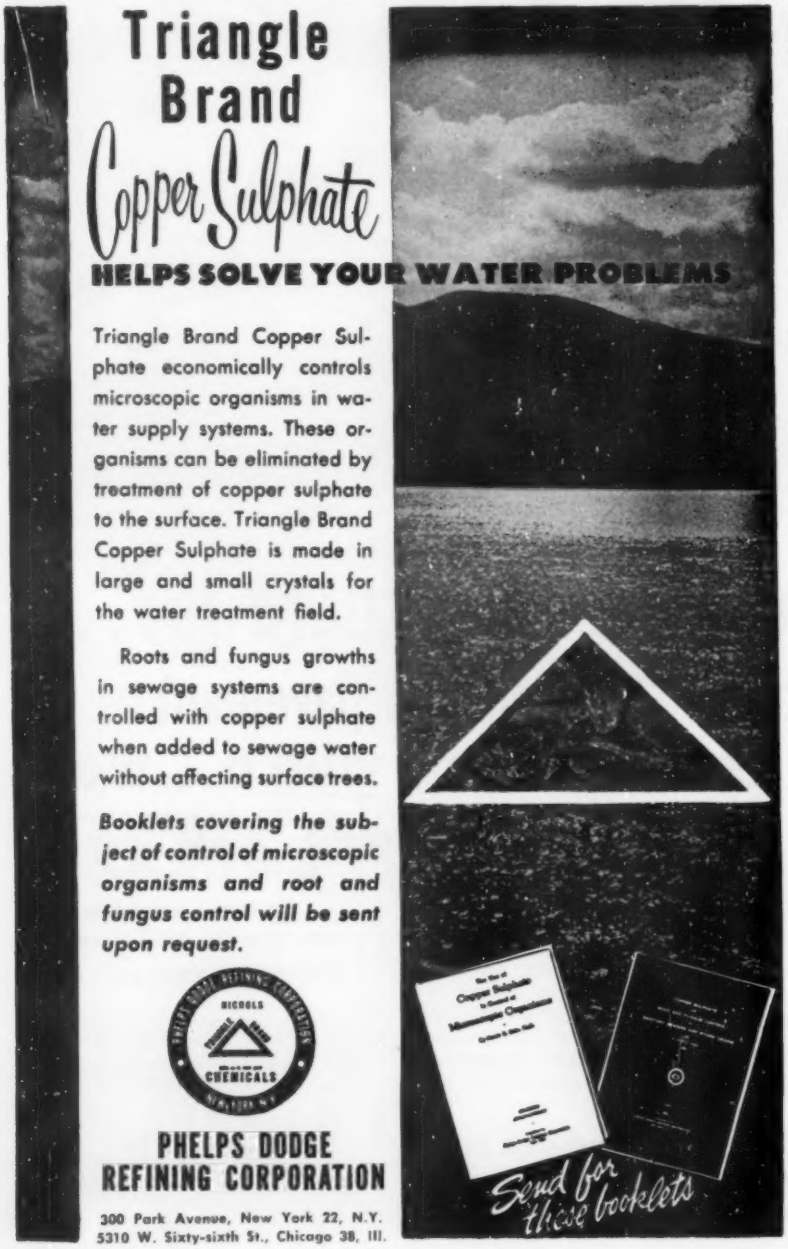
The New Jersey Garden State Parkway collected a total of $14,388,735 in tolls during 1957. The toll revenue was 17.2 percent or $2,109,395 above the previous year total. The 1957 toll income was also some $429,000 higher than the original estimate by the Authority's Consulting Traffic Engineers. The increase in toll income was partly due to the opening last Summer of a new 9½-mile section in Bergen County which links the Parkway directly to the New York State Thruway at the N.J.-N.Y. line.

Income from the operation of Parkway restaurants and gasoline stations under license agreements with established firms reached a total of $680,192 during the past year. This was $186,788 or 37.9 percent higher than in the previous year. The Authority's net revenue for 1957 was $11,786,597. The debt service payable from such net revenue was $9,464,093. Of the $2,322,504 remainder, approximately $1,892,800 represented the additional 20 percent coverage required by the General Bond Resolution, leaving a balance of approximately $429,700.

• • •

Benefit Charges for a Water Line

Extension of a water line on Alameda Ave., Cuyahoga Falls, O., cost $7,028.15 and benefited 42 properties, representing a charge per property of $167.34.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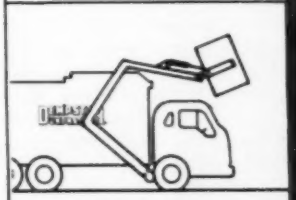
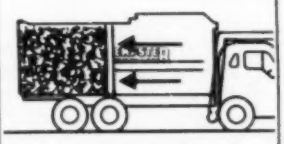


Hoists Containers Overhead

Empties and Puts Them Down



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NEW EQUIPMENT CUTS REFUSE COLLECTION COSTS FOR MAPLE HEIGHTS

IN A RECENT tabulation of refuse collection costs for the City of Maple Heights, Ohio, the city's director of public service, H. L. Trefsger, estimates that purchases of up-to-date equipment have saved the city $100,000 in the past five years.

"In 1953", states Trefsger, "We purchased four 16-yard Load-Packers to replace the same number of scow-end open dump trucks. This immediately cut our labor needs in half—releasing 16 men for other municipal work." With the open dumps, a crew of seven men were required for each truck. The Gar Wood Packers required only three crewmen.

In 1955, the city built a new incinerator which reduced the length of each haul by a good fifty percent. This saving forestalled new collection equipment purchases which would have been needed for the community's growing population. Late last year, when population pressure made it necessary to purchase an additional refuse collection unit, the city bought a new Gar Wood Load-Packer 500 with a 16-yard capacity. This new model is an hour to an hour and a half faster on the routes than the earlier models.

● **THREE-MAN crew can load simultaneously at wide hopper of new Load-Packer.**

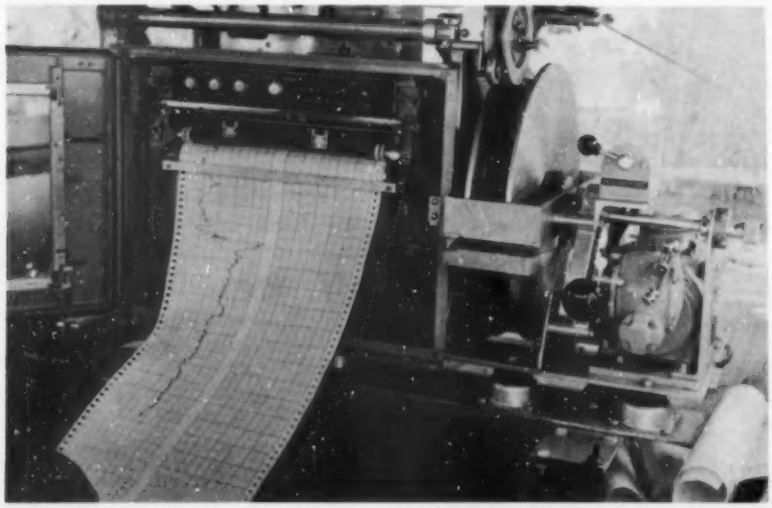
"We don't keep records of cost per refuse-ton, or cost per pick-up," states Trefsger, "but we do know that this year we'll be able to provide weekly curb pick-ups for this city of 30,000 at about $20,000 less than last year's cost—thanks to new equipment and new management methods."

A Way to Look Into the Earth

(*Continued from page* 123)

The true level of water-saturated soil usually can be determined from the resistivity curve as indicated by a sharp increase in earth electrical resistance wherever intergranular space contains air.

The geologic structure or attitude of the beds can be determined where geophysical logs are run in three or more wells in a given area. This information is not only useful in evaluating the geologic architecture of an area, it also permits better planning for additional test borings and for prospective sampling depths. Thin beds frequently are not detectable by any sampling method. These usually have geophysical properties that permit their detection in logging. Examples: sand streaks in clay, peat or lignite in sand or clay; clay streaks in sand; zones of cementation in sand.



● **RECORDING instrument in operating position for logging from a station wagon. The instrument contains rectifying, amplifying and dual channel recording circuits.**

Acknowledgement—The author is grateful to Hubert Guyod, Houston, Texas, a foremost authority on the theory of geophysical logging, for review of the manuscript and to Mrs. J. H. Bustetter, the author's secretary, for suggestions in composition.

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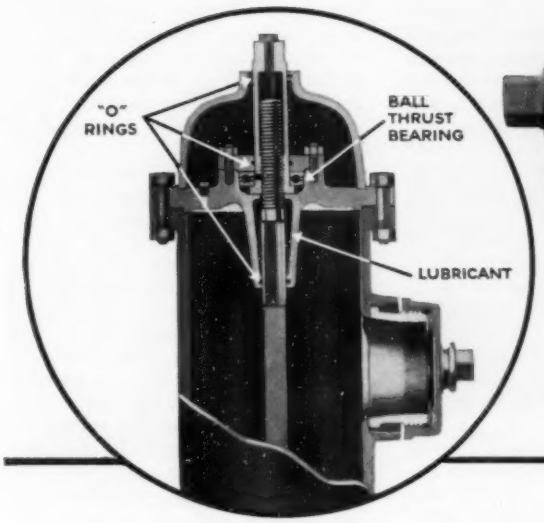
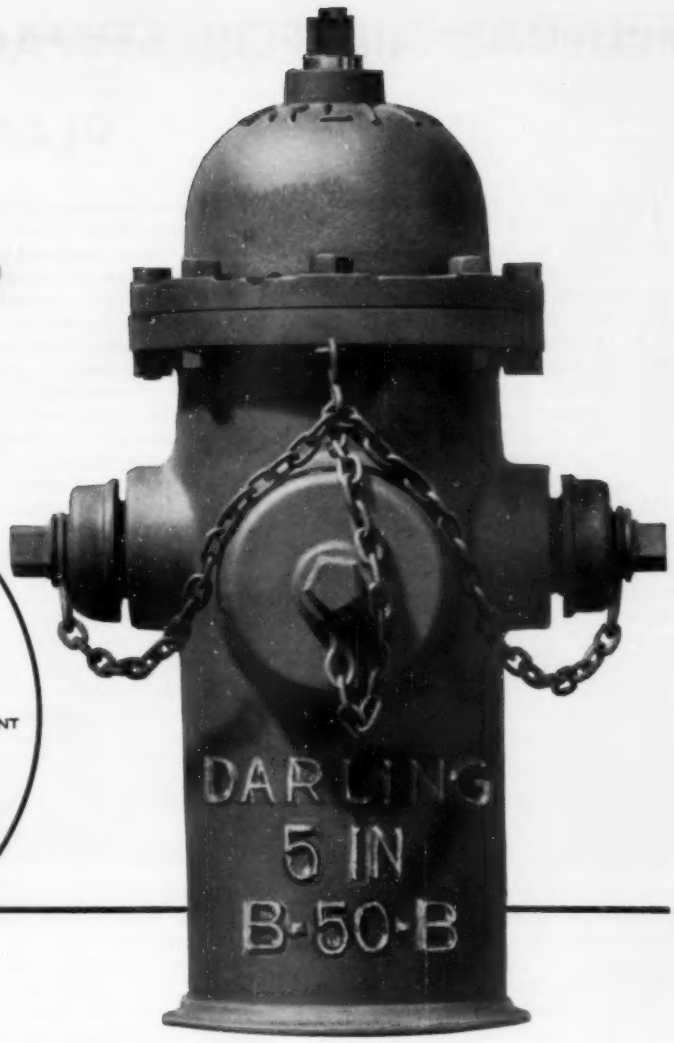
Oil Field Techniques Useful in Water Well Drilling, Harvey A. Mylander, Water Well Journal, November-December, 1955, January, 1956, and March, 1956.

Trouble hasn't a chance!





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FEDERAL AID FOR SEWAGE TREATMENT PLANT CONSTRUCTION

TRANSFER of some Federal tasks to State and local governments was urged by President Eisenhower in an address at the 1956 Governor's Conference. Later he appointed a Federal-State group to study Federal Programs and to recommend specific responsibilities which could be assumed by the states. Among the recommendations of this group was the termination of Federal financial support for the construction of sewage treatment works and the assumption of this responsibility by the states. State legislatures were asked to give financial support to municipalities for this program; to improve local governmental capacity to raise needed funds; and to strengthen state water pollution control programs.

As might be expected, these recommendations have been the subject of much controversy and disagreement. Most opposition has been based on a sincere doubt as to whether the states, or any reasonable number of them, were willing to assume these responsibilities if they were transferred from the Federal government. Among those opposing the transfer are state and local organizations representing municipal activities, fisheries, public health and conservation elements.

In the belief that the states will not, as a group, assume adequate responsibility in this field, the Editor of PUBLIC WORKS has gone into some of the background leading up to the enactment of Public Law 660, providing grants-in-aid; and has also surveyed some of the results obtained by the operation of the program over the approximately 18 months that the law has been functioning.

Legislative History

In the first place, the idea of Federal assistance is by no means new; Congress has long been aware of the need for a program of water pollution control, national in scope and financed, in part, from Federal funds. Bills were introduced into Congress in 1936, 1938 and 1940, but failed of passage or were vetoed on technical grounds. In 1948, in the course of hearings on the bi-partisan Barkley-Taft bill, Senator Taft stated that Federal water pollution control legislation was vital and that the interstate aspects of the problem clearly established Federal interest and responsibility. This bill proposed to extend financial support in the form of grants-in-aid, loans or both to any State, municipality or other public body for the construction of necessary treatment works. The suggested annual appropriation was $100 million, with aid of one-third of the plant costs to municipalities and loans to industries. The program was intended to extend over ten years. Support for this program came from many sources.

This bill was passed by Congress in a modified form, but on the last day of the session, so that no appropriation to effect its provisions was made. In the following year, limited funds were voted but withheld by the Bureau of the Budget because of the Korean War. The 82nd Congress passed another act, and authorized funds which were never appropriated. Again in 1955 and early 1956, the problem was considered, but it was not until July, 1956, that Public Law 660 became effective. The fight had lasted 20 years.

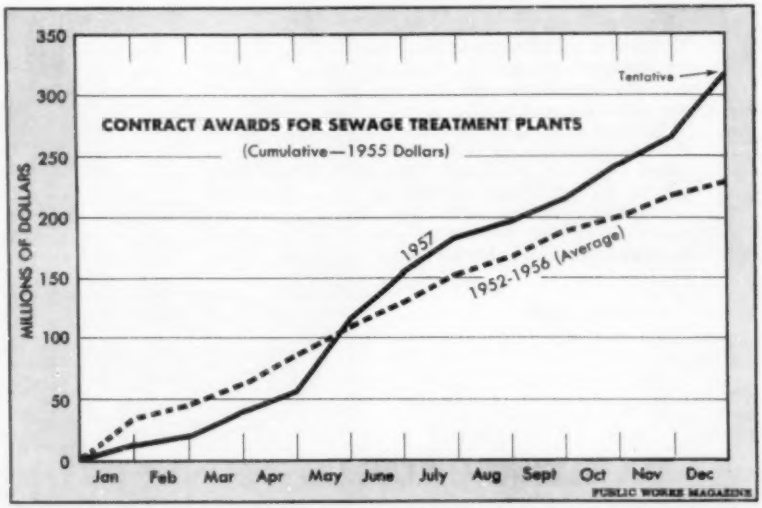
The financial provisions of PL 660 are well known. Appropriations were made by Congress in the amount of $50 million for FY 1957 (the year ending June 30, 1957) and $45 million for FY 1958, the latter permitting allotments to states on the basis of the full $50 million authorization. There seems to be no doubt that an appropriation of generally the same amount will be available for FY 1959.

Organization of Program

The construction grants program has now been in operation for approximately 18 months and an examination of its administration should determine whether the use of Federal grants for this purpose has produced a Federal giveaway program and usurpation of State responsibilities in the field of water pollution control, or has resulted in the efficient and cooperative Federal-State partnership envisaged by the Congress.

In order to assure a maximum opportunity for familiarity with the State and local water pollution control problems and personal contact with State officials, the Public Health Service wisely decentralized the administration of construction grants to nine regional offices. This did not represent any departure from established policy. Existing water pollution control staffs were expanded to assume the added responsibility. Responsibility for general program policy, planning, and evaluation was retained in Washington.

As is generally known, the communities requesting Federal grants submit their applications to the State water pollution control agencies. These are reviewed by the



● **CURVES show contract awards for sewage treatment plant construction, based on 1955 dollars. The effect of the grant-in-aid program is indicated by rising line.**

States to determine project eligibility and conformance with the State water pollution control plan. Approved applications which have been certified by the States as entitled to priority are then forwarded to the appropriate Public Health Service Regional Office for processing and grant offer.

Following review by the Public Health Service to assure conformance with legislative requirements, a grant offer is made by the Regional Office to eligible applicants.

Subsequent project supervision by the Public Health Service Regional Office includes the review of plans and specifications to assure an operable treatment works, authorization for the taking of bids and contract awards, project inspections, grant payments and final audit.

The Public Health Service has made an effective effort to cut red tape and to simplify its administrative requirements to the maximum possible extent consistent with its responsibilities. From your Editor's experience and from his discussions with engineers and state health officials, he believes they have done well in this respect. Sufficient flexibility has been maintained to care for special problems as they arise. In some cases, staff engineers have been temporarily assigned to State offices to assist in the review of applications and other project documents when this would tend to cut down processing time and aid the State effort. Federal administrative costs have been held to 1¼ percent of appropriated grant funds. This is an exceptionally low overhead for a program of this type.

Effect on Progress

The measure of effectiveness of the construction grants provisions of the Act as a pollution abatement measure is the stimulation provided to sewage treatment works construction. Preliminary contract award data for 1957 indicate that there has been an increase of about one-third in the annual rate of construction of sewage treatment works during the first full year of operation of the construction grants program over the five-year annual average for the period 1952 through 1956. That it was accomplished in spite of the most unfavorable municipal bond market in many years is an added credit to the program.

There is no doubt but that the program initially and temporarily slowed plant construction, probably for a 6-month period. However, this has been overcome and many communities hitherto unwilling or unable to build plants have gone ahead. The effect has been especially marked in smaller plant construction; 96 percent of all grants have been to communities of less than 125,000 population.

A year ago, PUBLIC WORKS wrote all State Sanitary Engineers to determine their reactions to the program. Of 37 replies, 23 said that the program had stimulated construction and aided materially in water pollution control; 11 said it was then too early to reach any sound conclusion; and three opposed the program. Last August the *Engineering News-Record* surveyed state water pollution agencies and municipalities and reported an overwhelming approval for the program. The consensus of opinion was that many municipalities receiving grants have been able to build what previously had been impossible or difficult or incomplete.

As of Jan. 31, 1958, grant offers had been made to 875 communities. The estimated project cost of these was $347 million while the grants offered totaled $73 million. Applications in progress numbered 637 and under preparation 289, these together totaling an additional $718 million cost and $92 million grants. The total of grant offers made, in process and under preparation is 1801, representing a total cost of $1,065 million and grant offers made or requested of $165 million. It will be noted that applications approved, in process or under preparation request grant funds 72 percent in excess of existing appropriations which will support approximately 1140 projects.

Of the projects, 47 have been completed as of Jan. 1, 1958; 358 are under construction and 423 others are approved but are not yet under construction. It is of interest to note that the first 680 projects approved will provide adequate treatment for a population in excess of 12,000,000. Of 546 projects studied from the viewpoint of improved stream conditions, 6300 miles of streams will be brought to levels conforming to State Water Pollution Control plans.

Yet it appears that many states are not taking adequate advantage of this program. As of Jan. 1, 1958, only eight states had utilized a full 100 percent of the grants available to them; only 23 had obligated as much as 75 percent of their grant allotments.

Some states have taken the initiative since the enactment of PL 660 in providing State grants in support of sewage treatment plant construction. Maine appropriated $836,000 for the two fiscal years ending June 30, 1959 authorizing the State Water Improvement Commission to pay up to 20 percent of the total cost of needed projects, or 2/3 of the Federal contribution under PL 660.

● **COMPLETE treatment plant at Hallettsville, Tex., is an example of the type of plant built under the Federal Aid program. Total cost $99,000; grant $28,650.**

Vermont established a fund of $1,000,000 by State bond issue to encourage water pollution control at the local level through State aid for the construction of sewage treatment plants by municipalities. Grants of 20 percent of the cost of construction were authorized. The Maryland legislature authorized a fund of $5,000,000 (to be established by State loan) to be used to supplement grants made under PL 660. In addition to these, New Mexico provided modest grant-in-aid support in 1957 for meeting the construction needs of unincorporated municipalities. Ohio made funds available for planning grants and New Hampshire raised the ceiling on loan guarantees during the same year. Prior to 1957, California, Oregon and Pennsylvania had inaugurated State financial aid programs involving loans; state purchase of municipal bonds; and annual payments for operation, maintenance, and replacement. The fact that the bulk of these State financial assistance programs were inaugurated subsequent to the passage of the Federal grant program leaves little doubt

as to the marked effect which PL 660 has had in creaing a feeling of increased responsibility on the part of some States in the provision of financial aid for this purpose.

These developments are hopeful but provide no reason for believing that the States can be relied on to assume any large-scale grant-in-aid or similar needed program in case Federal assistance is terminated. And the excess of applications under PL 660 for grants over and above the amount presently available indicates at once the need for and acceptance of the program.

One more phase seems important and that is better operation. Few of our states have adequate systems for training and sustaining plant operators. No matter how well the need for more sewage treatment plant construction is recognized and how willing Congress, or the states, may be to continue the program, it is vitally necessary that the plants built under this program be operated intelligently and effectively. Unless this is assured, no program of the sort can long endure. The responsibility for operation is clearly a state obligation which up to now has been honored generally more in the breach than in the observance.

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Highway Construction in North Carolina

The North Carolina State Highway Commission achieved a new high level of construction progress during 1957. Highway contracts brought to completion during 1957 involved values of $40,388,613. $65,-335,481 worth of contracts were let during the year while the value of active contracts increased from $43,-222,561 on January 1, 1957 to $68,-169,429 on December 31. A total of $108,558,042 in contract values were active at sometime during the year.

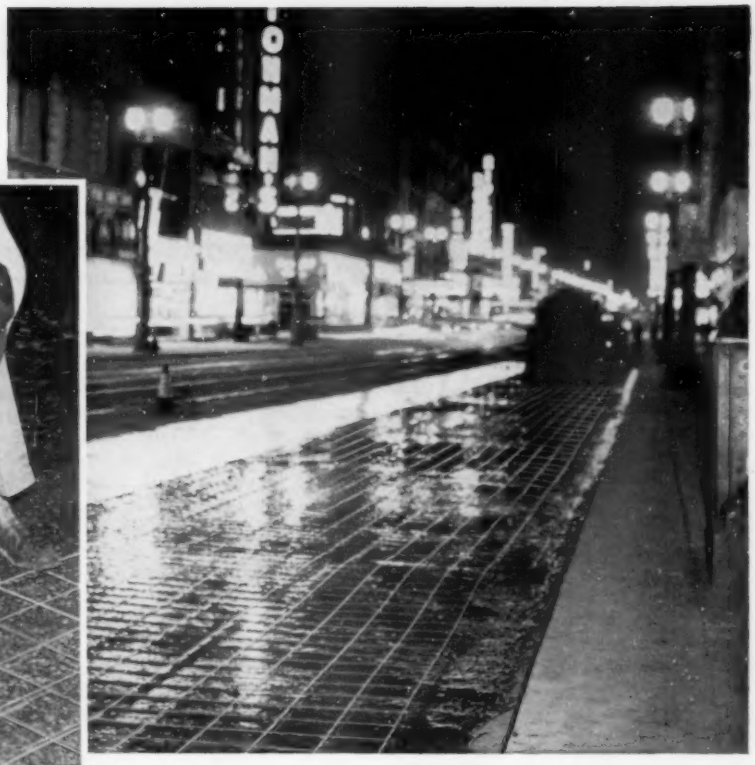
Work on North Carolina's 677-mile Interstate Highway System accounted for a considerable share of the progress. About one-fifth of the contract work brought to completion in the past 12 months was on the Interstate System. Contract lettings during the year on the Interstate program amounted to approximately 40 percent of the total contract value and 40 percent of the highway work still underway at the end of the year was on the Interstate.

During 1957, the State Highway Commission let 269 improvement contracts on some 1,254 miles of roadway involving some 108 contracting firms; 44 of the 269 contracts were on the Interstate system with a value of $25,924,248; 106 of the 1957 contract lettings were completed with a total value of $11,310,-629. Nine of these completed projects let during 1957 were on the Interstate system with a total value of $2,087,197. While the contract value represented approximately $65,000,000, this figure does not include right-of-way acquisition and engineering contingencies. If these two items were included, the cost of 1957 improvements on North Carolina's highway system would exceed $85,000,000.

Robot Tractor for Use in Dangerous Areas

The radio controlled tractor under test by the U. S. Army Engineer Research and Development Laboratories at Fort Belvoir is, in prototype, the "tournadozer," made by Le Tourneau - Westinghouse. The tractor has been equipped with a radio receiver which operates all controls upon receipt of appropriate signals from a transmitter at a location within 15 miles of the tractor. It is considered to be of value for construction work or other operations in zones that are dangerous to habitation such as radioactive areas and combat zones, and for fighting fuel tank fires.

Contractor:
BRIDGES ASPHALT PAVING COMPANY
St. Louis, Missouri



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SUBURBS *need* Public Sewers

IT IS AGREED by sanitary and public health engineers that the only satisfactory way to dispose of domestic sewage is by public sewers with subsequent adequate treatment. The Association of Home Builders concurs with this. We in the Health Department, however, still receive for approval plans of even large subdivisions with septic tank installations and, in too many cases, approve them knowing that private sewage, regardless of the conditions, is a temporary solution.

Under pressure of work, we sometimes take the easiest path. It is simpler to review a plan for 50 or even 200 lots with septic tanks than to insist upon or to promote a public sewerage system. The consultant shows only a typical lot layout. Too often municipal officials are not concerned with creation of sewer districts, inspections, maintenance and operation. The builder has a great deal of money tied up. But the last man, the buyer, is faced with private sewerage that may function satisfactorily for 15 or 20 years, but also may fail within a few months.

The problems and inconveniences that will result from following such a path are obvious. We must make efforts to control or to direct effectively the nature of developments. Our efforts will run counter to many strong forces, economic and other, but our profession must take the leadership to attempt to overcome the obstacles that have presented themselves, obstacles which have deterred the construction of sewers, particularly in subdivisions.

The ideas and recommendations that follow have been submitted by members of our committee to assist in promoting public sewerage systems for new and growing communities.

Planning

The outstanding deficiency in all sewerage and subdivision problems is lack of planning, by the health departments, and the municipalities and counties. Each sewerage project and subdivision should be reviewed or studied as part of a growing community. To make such a review we need information for determining what effect our approval or disapproval might have in the future. Many times all of us, long after we have approved something, wished we had not. Let us insist upon the towns having a comprehensive overall plan before we approve sewerage systems or subdivisions. Perhaps disapproval of some of the subdivisions would serve to stimulate thinking on the part of the municipal officials. Adequate plans should indicate locations for sewage plants, rights-of-way for trunk sewers, parks, zoning and area requirements, schools, streams and drainage areas.

The county also should have comprehensive and flexible plans and the plans of the towns must be coordinated or integrated with those of the county. Such planning will prevent sewage plants being built in residential areas,and avoid problems of inability to obtain needed rights-of-way and using undercapacity streams for sewage effluent, and installing trunk sewers and interceptors too high for future laterals. Sewerage systems are best designed and operated on drainage basin concepts, so regional or county district plans should be considered whenever and wherever possible. There should be legislation, if needed, to permit municipalities and counties to buy sites for sewage plants in anticipation of needs.

New York State encourages town planning. The Bureau of Planning of the State Department of Commerce has funds and assistance for planning available to towns under 25,000. The towns can adopt and enforce subdivision regulations. In Erie County there are at least two towns that do not permit subdivision with private sewage disposal. The health department cannot accomplish this objective alone; other official and private agencies perhaps have equal or greater responsibilities.

This article is based on a report of the Committee of the New York State Public Health Association to study the problem of providing public sewerage in realty subdivisions. The report was presented to the Association at its annual conference in June, 1957 by M. J. Stankewich, Committee Chairman and Assistant Director, Division of Environmental Sanitation, Erie County Health Department.

Regulation Required

All committee members but one are definitely opposed to septic tank installations in realty subdivisions in built-up or potentially built-up areas, regardless of soil and ground water conditions. Septic tanks should be reserved for use in predominantly rural areas. In general as population density approaches 1.5 persons per acre, the need for public sewerage systems is recognized. Also trunk sewers are financially feasible when the gross population density is 5 persons per acre.

In Westchester County, New York, regulations call for sufficient lot space or area to replace tile fields in new locations, where public sewers are not definitely planned in the near future. A similar recommendation is that if public sewers cannot be made available to an area within the foreseeable future and there is a demand for approval of tract maps, the minimum size lot approved should be one acre. One state district engineer reports that tightening up on soil percolation tests and not allowing a variation of more than 2 percent between successive runs in the 30 to 60-minute range has resulted in the practical elimination of septic tanks for realty subdivisions in this soils range. Requiring creation of a sewer district and construction of laterals in conjunction with individual septic tanks is also worth consideration. In a case where a builder proposes 200 houses with public sewers but wishes to develop a first section of about 50 with septic tanks, the formation of a sewer district should be required before approving any septic tank systems

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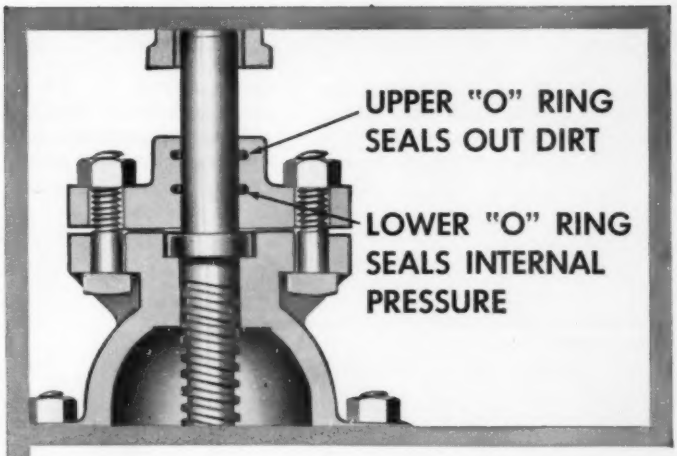

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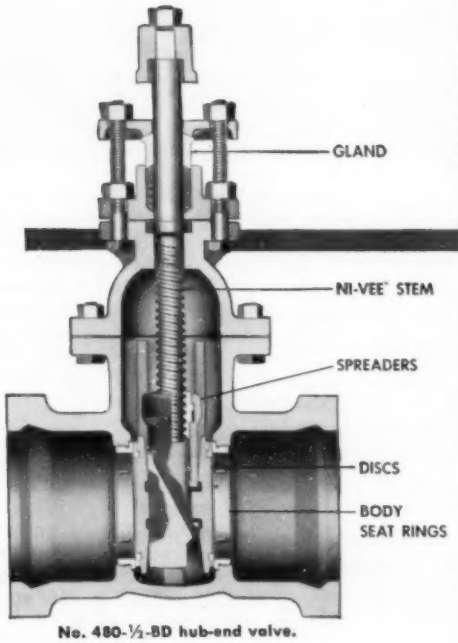

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for temporary use. The installation of sewers and a sewage treatment plant, if required, could be guaranteed by the posting of a performance bond.

Educational Measures

It is the unanimous opinion that we also must sell the benefits of a public sewerage system over private disposal to public officials and builders. To public officials we can demonstrate what happens in built-up communities when septic tanks begin to fail and the effects of health hazards upon the community, the bad feelings among neighbors and the loss of interest in homes and landscaping. To the builder, we can demonstrate costs and profits, for after all they would not be in business were it not for profit. According to C. C. Spencer, based on studies of Clarence Velz showing cost of public sewage treatment as of 1956, the cost per house for public sewers and treatment was lower than that for septic tank installations. The cost of septic tank systems according to reports varied from $250 to $2000. In Erie County it varies from $400 to $1500.

A contractor may lower sewer and plant costs by doing work while his equipment is on the site. Also, the contractor can build a plant in sections or on a program basis as his housing development progresses. The realty developer can divide his property into more lots when public sewers are proposed. In Erie County, it is believed that local zoning boards should permit a 20 percent reduction in street frontage and 40 percent reduction in lot areas where public sewers are provided. There are objections on the part of builders or subdividers that the construction of a public sewerage system ties up capital funds. This can be overcome somewhat by stage construction of the sewerage facilities, but we should require intelligent planning and design and legal commitments.

An overall plan for sewering a township or a large area of a township eliminates the problem of patchwork design, at least to the point that sewers, when installed, should be in general agreement with the overall plan. If overall planning exists as the town develops, small treatment plants could be installed for temporary service—to be abandoned in 10, 20 or 25 years when sufficient development has occurred to enable the construction of a large plant. One well paid, competent man should be able to handle several small plants if they are not too widely scattered.

Patchwork sewage treatment on a non-integrated basis merely presents the health departments and municipalities with additional problems. However, if planning is good, many of the small treatment plants can ultimately be discontinued and possibly converted to pumping stations, if necessary, when the area involved in the comprehensive plan is fully developed. The design should be in accordance with stream requirements and in agreement with existing good practice and established standards.

Annexed Subdivisions

If a subdivider can have his adjoining land annexed to a village or city having a sewer system, or have a town district created, and obtain sewer service from a nearby district, village or city, neither private sewage disposal systems nor small central systems should be permitted. The controversy then is usually over entrance fees and annual charges. The Town of Greece requires a $500-per-house entrance fee to be paid by the developer, and this is used to set up a sinking fund to finance future needed expansion and improvement in the sewage treatment works. The

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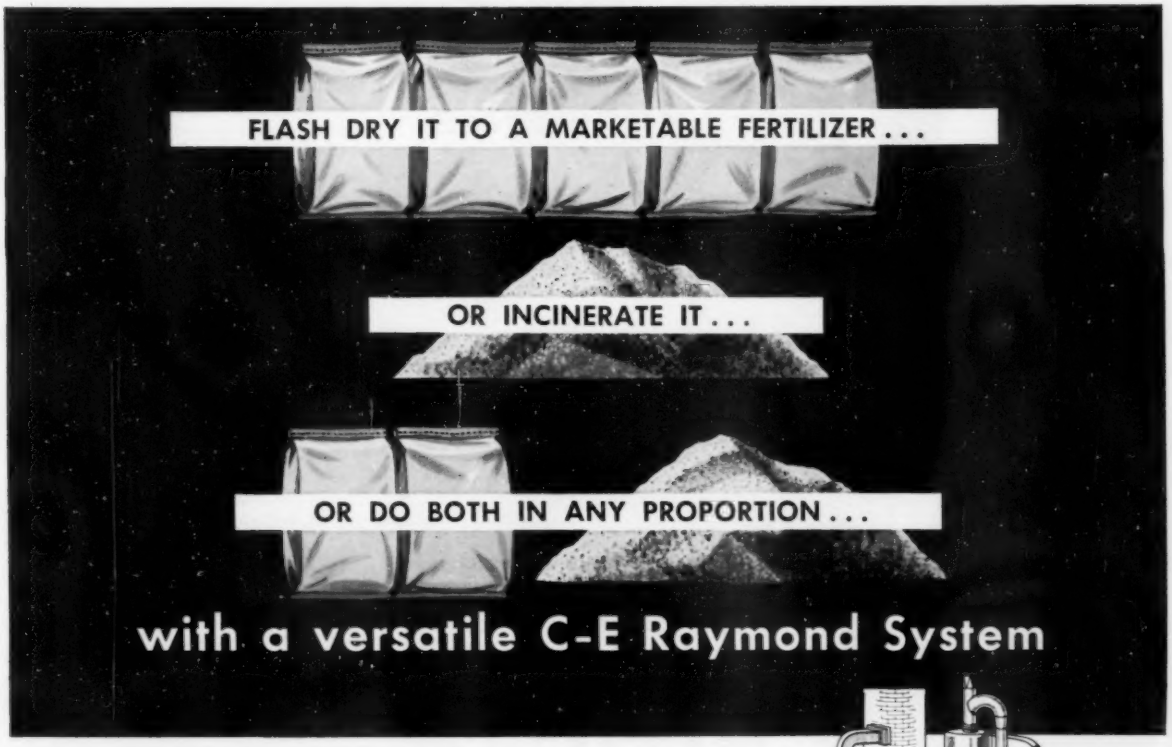

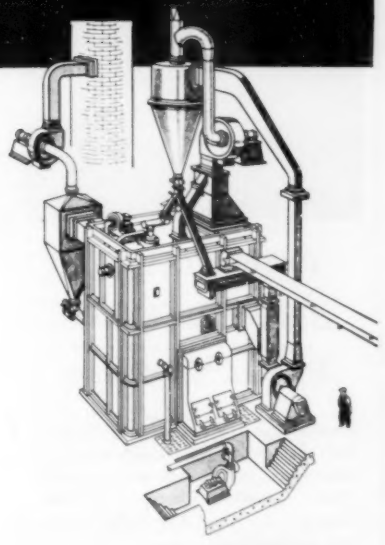

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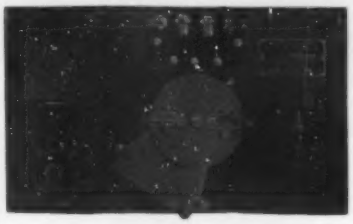

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Village of Orchard Park in annexing property, charges $405 per lot also for a sinking fund. Sewer districts obtaining treatment services from a nearby town or city have been paying from $18 to $35 per house. Requiring a developer to contribute a certain amount per house or lot has many precedents in streets, schools and water.

It is better to have the costs of the needed improvements reflected in the price of the house before the prospective house owner makes his purchase, than for him to be hit with a sewer assessment later on.

Where it is available to build a large sewer primarily to take care of future development or where the municipal sewer system is inadequate for a subdivision load, the question arises as to how the costs shall be apportioned. One suggestion is: "The benefiting community should pay for running large sewers within an adjoining municipality if this is necessary." This has been done in Rensselaer County where the adjoining town paid the cost of extending larger sewers within the limits of the city handling disposal. However, the developer should not pay the total cost of providing a sewer that is more than adequate for his own needs. With appropriate legal provisions, there is no reason why he cannot be reimbursed in the same fashion that is presently used for water main construction.

There are cases where the sewers in the municipality offering sewage treatment services to outside areas are of small size and adequate to serve not only projected sewer developments but its own needs. By making an engineering and financial arrangement they may not only solve their own problem of surcharged sewers, but help adjoining and nearby sections.

There appears to be unanimous agreement among committee members that there is need for revision of existing New York State law giving authority to at least first class towns as far as sewerage construction is concerned, as is now possessed by cities and villages, to eliminate need of "51" percent petitions.

To a suggestion that it may be feasible to operate trunks, interceptors, and plants as public utilities by subdividers and businessmen where town boards are reluctant to form districts to operate them, two members of the committee favored the idea and one had no objections to the public utility idea as it is being practiced in Florida.

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THE STREET department of Dayton, Ohio, purchased a Marion 35-M last summer. This ¾-yd. machine is equipped for hoe, clam, crane and dragline operation and is powered by a GM 3055-C engine with Torcon converter. As a utility machine, the shovel has a variety of jobs to perform. So far the street department has used it for crown reduction on gravel and asphalt roadways, gravel pit excavation and salt stock-piling and truck loading. It is kept busy as it works only a 40-hr. week on these many jobs.

Another air-controlled 35-M was purchased by the water department a few months before the street department machine went to work. It also has hoe, clam, crane and dragline equipment and is powered by a GM engine with a Torcon converter. The work this ¾-yd. Marion is assigned to consists mainly of pipe line excavation, pipe stockpiling, loading and unloading. This unit, like the street department machine, also works an eight-hour day, five days per week.

A centrally located service garage is planned for the Dayton Motor Vehicle division. This will combine the facilities of the light equipment garage on Kiser St., headed by Herman Burns, with the heavy equipment garage on Ottawa St., headed by Robert Hudson. The city owns more than 450 pieces of equipment and the 300-acre Ottawa St. yard includes storage warehouses and material stockpiles, in addition to the shop.

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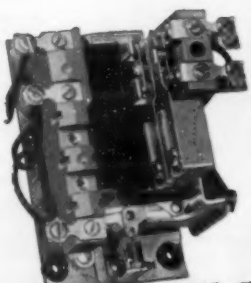

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THE MEMBRANE FILTER TECHNIQUE

(*Continued from page* 113)

necessitating dilution or the use of either small sample quantities or composite results of two or more membrane analyses. Furthermore, unusual amounts of particulate matter on the filter surface may contribute to colony coalescence or otherwise interfere with coliform differentiation. Variations in ability of analysts to identify coliforms because of atypical sheen development might, of course, cause inconsistencies in test results. Skill in selecting a satisfactory sample volume and in differentiating coliform colony characteristics improves with training and experience.

When 10-ml portions of a standard sample are examined by the MPN method it is difficult to obtain a precise indication of coliform density when the organisms are present in the sample in quantities of 1.0 per 100 ml or less. The membrane filter procedure combats this deficiency by affording opportunity for analysis of larger, and more representative sample volumes —100 ml or more—an especially valuable feature in control of water plant operation and sanitary maintenance of potable water distribution systems. It should be noted, however, that it is not imperative to use larger sample volumes than required for MPN evaluations to obtain results of comparable precision.

In addition to the all-important rapidity of precise sample evaluations, the membrane filter technic requires less laboratory glassware, culture media, and incubator space, and less preparation and wash-up time than is required for conventional procedures. Comparative analyses of more than 8000 samples since 1952 by the Los Angeles County Sanitation District demonstrate more than a four-fold savings in time and also a very substantial savings in laboratory glassware and media required[26].

A number of attempts have been made to develop comparative cost estimates between the membrane and MPN procedures. The evaluations are of limited value since they are based on assumptions that may have only local validity. Moreover, there are many factors involved in such an evaluation that are difficult to apprize—savings reflected in elimination of refrigerated bulk water-sample shipments, in space requirements, in technician processing time (including preparation and clean up), etc. Furthermore the value to the sanitary authority of obtaining water quality reports within 24 hours of the time of sample collection can not be meas-

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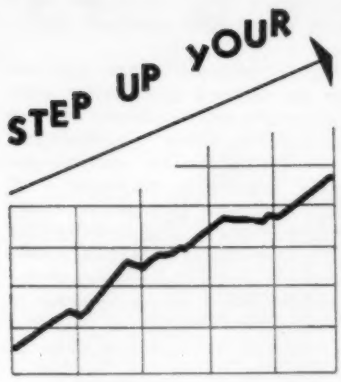

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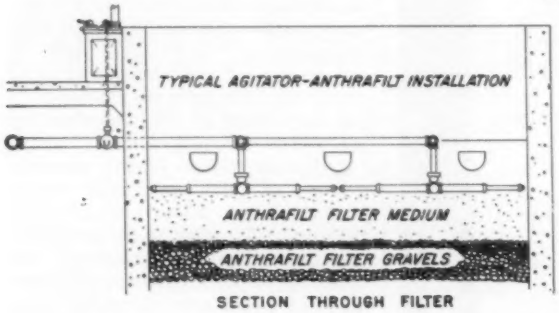

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SIZES—Palmer Agitators are adaptable to any size or type of filter. Available in lengths up to 15'.

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STREET WASHERS

ured. In "clearing" new pipeline systems for service, for example, this feature is of considerable economic and public relations importance.

With membrane filter technics thus far devised quantitative coliform results can be obtained in less than 24 hours, either in a laboratory or in the field. The conventional method required a minimum of 48 hours to obtain a negative result and sometimes as long as 6 days for a completed test. For certain waters it appears that the reduction in incubation time causes a decrease in the efficiency of coliform recovery. Refinements in standardization of realistic and effective incubation and culturing conditions are indicated, although routine application need not be delayed pending their development.

Other Sanitary Uses

Additional applications of interest to sanitary authorities where membrane filters are reported to have been used successfully include:

1. Isolation of *S. typhosa* and cysts of *E. histolytica* in suspected or confirmed water-borne disease outbreaks.
2. Enumeration of enterococcus as an index of sanitary quality of potable and bathing waters.
3. Determination of coliform-density values as a measure of sanitary quality of shellfish-growing waters.
4. Assay of microplankton and study of photosynthetic productivity by radioassay of C^{14} absorbed by membrane-retained cells.
5. Determination of the sanitary quality of milk and other dairy products as an adjunct to accepted technics. (The City of Flint, Michigan uses the technic routinely for quantitative determination of thermoduric organisms surviving pasteurization. An analytical procedure for coliforms and total colony count is being tested under cognizance of the American Public Health Association at Albany, Chicago, Lansing, Madison and St. Paul.)
6. Obtaining graphical records of *Chlorella* and other small green algae that dominate water distribution systems enriched by small amounts of nitrogen-rich wastes.
7. Appraisal and counter-defense against BW and RW attack (e.g., use of the membrane filter to concentrate alpha- and beta-emitters in large samples of air or water).
8. Particle-size distribution and assay of indoor and outdoor atmospheric contaminants.
9. Analysis of the effectiveness of sanitizing procedures for in-place

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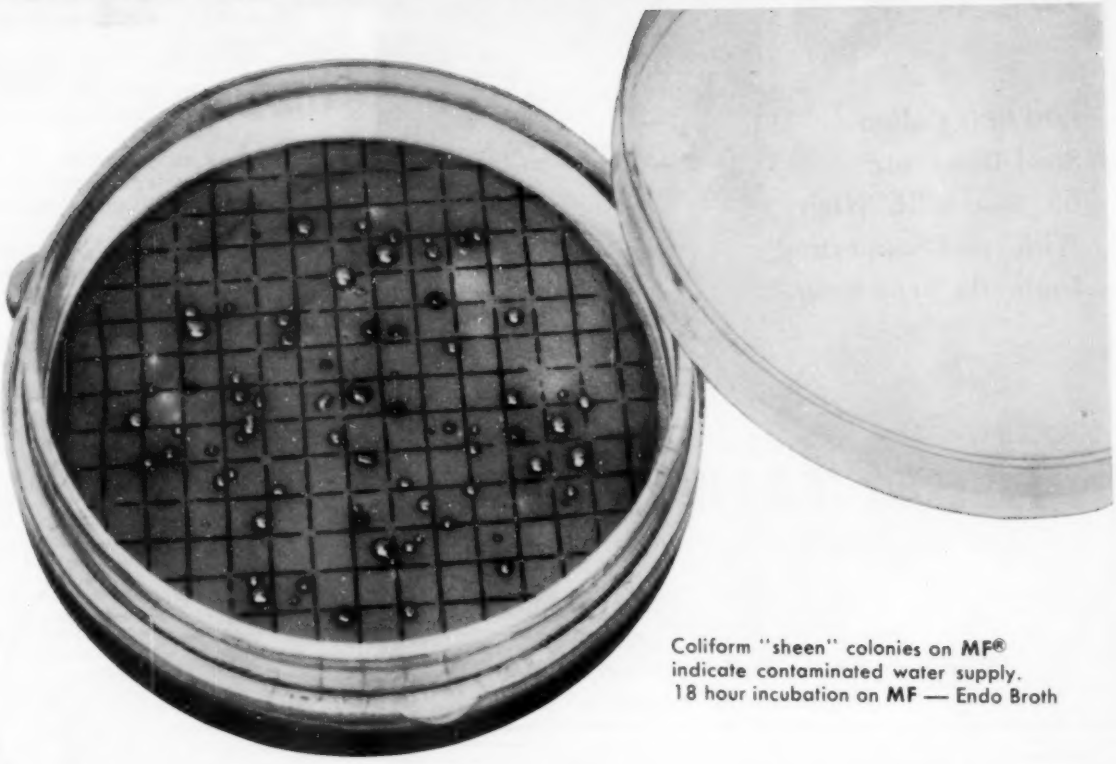

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cleaning and germicidal treatment of milk conduits, bottles and other equipment associated with dairy sanitation, including aerosol assay of enclosed areas of sanitary significance.

10. Evaluation of the efficiency of disinfectants, detergent germicides and antiseptics, including procedures of use.

11. Analysis of sewage and other liquid wastes, e.g. measuring aeration solids in activated-sludge mixed liquor suspensions.

12. Undoubtedly the future will bring considerable refinement in existing technics as well as the introduction of other applications. It is anticipated that these will contribute to a more satisfactory evaluation than currently exists of many and varied environmental factors of sanitary importance.

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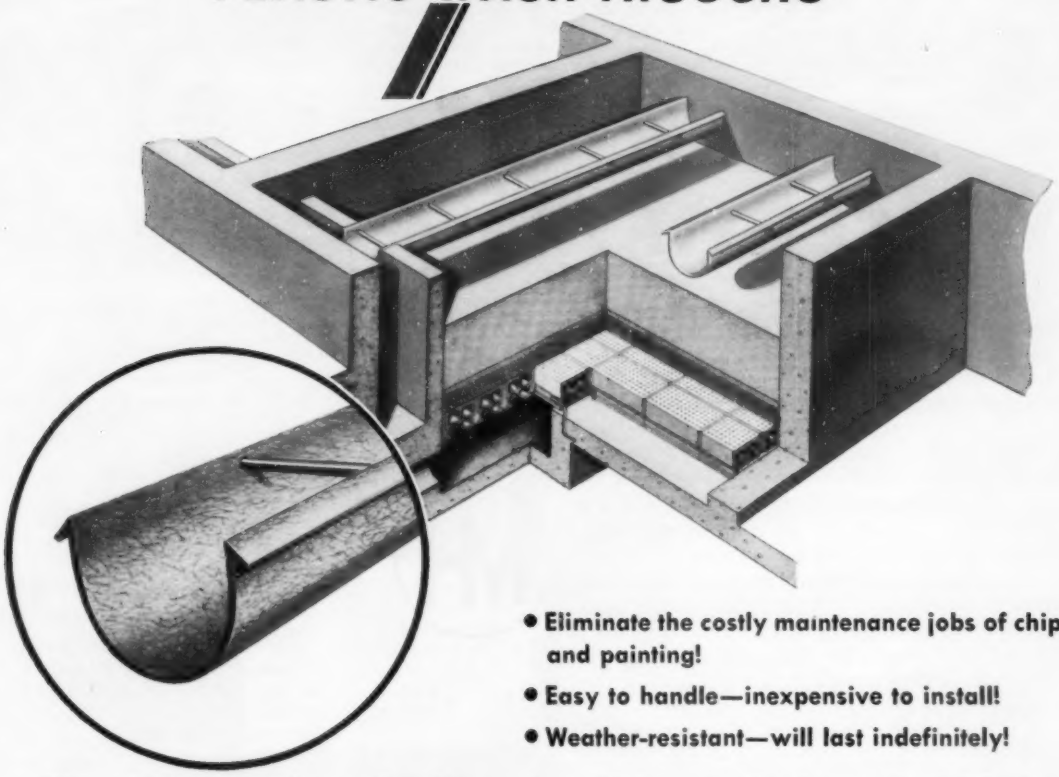

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M & H welcomes the suggestion of the American Water Works Association to certify the quality of products made to conform to current AWWA specifications. This is a matter of importance to the water works industry. For the present, the procedure is not completely resolved; nevertheless the program as such will reflect a valuable contribution to users of water works materials.

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M & H products have been developed through many years of research in engineering, design, foundry practice and water works operation. This Company's greatest asset today is the confidence of engineers in the quality and high standards of its products.

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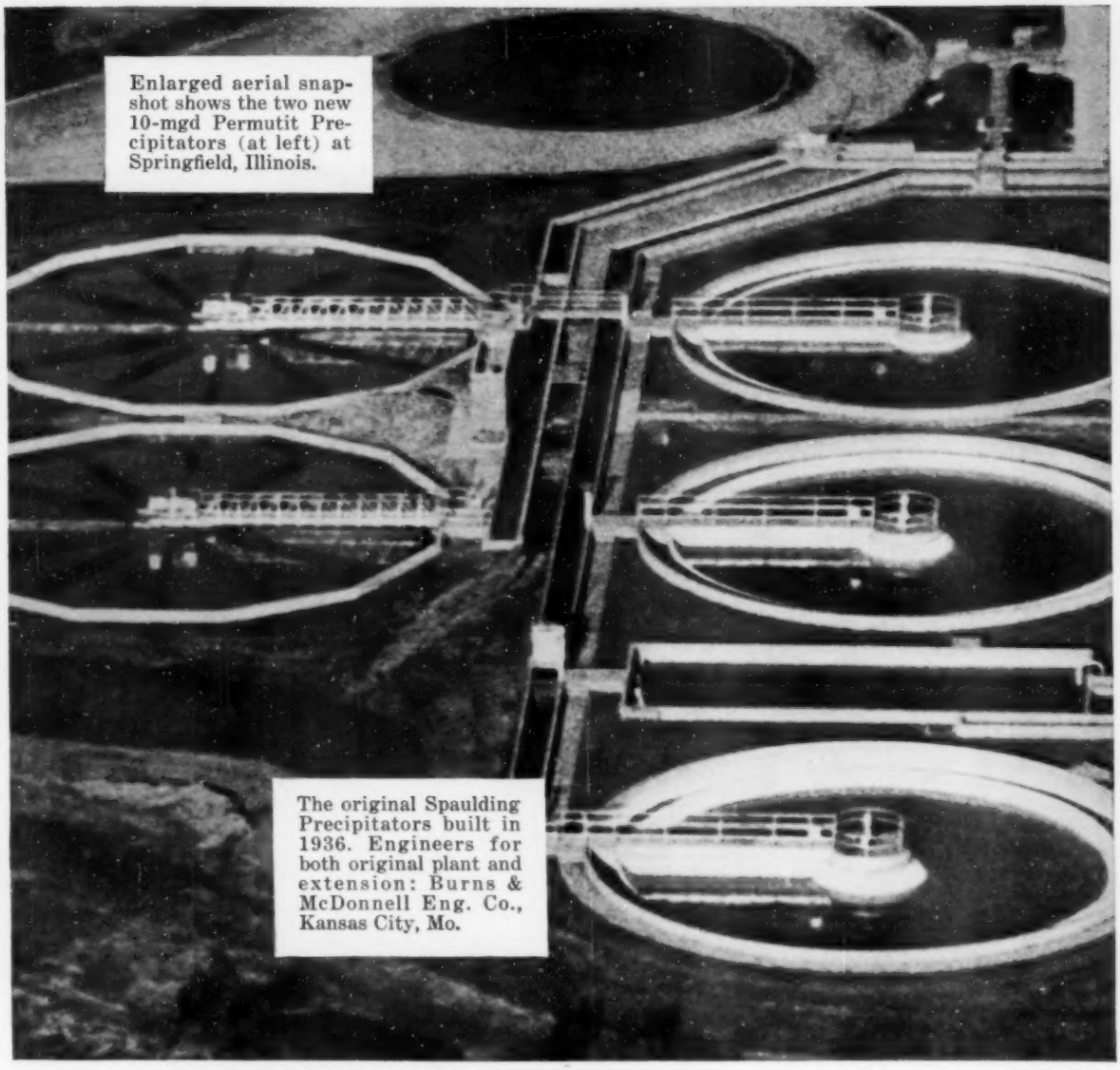
Sewage Treatment by Arlington County

The total flow through the Arlington Co., Va., sewage treatment plant for the 1957 fiscal year was 4,984.7 million gallons. The average daily flow was 14.08 million gallons. The plant renders primary treatment to all Arlington County sewage. The treatment process removed an average of 77.9 percent of the suspended solids and 45.3 percent of the biochemical oxygen demand. A total of 4,577 tons of sludge cake was produced by the vacuum filters. The estimated sludge gas production was 170,000 cubic feet per day. Cost of sewage plant operation was $1.27 per capita.

Maintenance Program in Maryland

Maintenance crews in Maryland maintain approximately 4700 miles of road on the state highway system, or about 63,000,000 square yards of road surface over which the daily average estimated vehicle-miles of travel is in the neighborhood of 15,342,000. The maintenance bill for the calendar year 1957 was $8,589,764. It took $343,004 to keep Maryland roads passable during and after 3 snow storms of the past winter.



Enlarged aerial snapshot shows the two new 10-mgd Permutit Precipitators (at left) at Springfield, Illinois.

The original Spaulding Precipitators built in 1936. Engineers for both original plant and extension: Burns & McDonnell Eng. Co., Kansas City, Mo.

20-year record proves efficiency of upflow "Precipitators"

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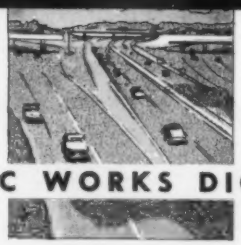


PUBLIC WORKS DIGESTS

Prepared by

FRANK FORCE

Associate Editor

THE HIGHWAY AND AIRPORT DIGEST

Road Tests Determine: What Makes Autos Skid?

Mindful that ever-increasing motor vehicle speeds demand a pavement that will insure sufficient skid-resistance for safe stopping, the Mississippi State Highway Dept. set out to measure dry and wet stopping distances on all major types of surface on the state maintained system. The tests developed further data on the fact that skidding is principally a function of tire tread and pavement texture. It is influenced by tire balance, brake adjustment, pavement irregularities, crown of pavement, transverse dips, temperature of pavement and other factors. Also developed were standards for skidding resistance, in terms of 3 ranges of coefficient of friction, denoting "good" resistance, "satisfactory" resistance and "satisfactory with exceptions." Results show that if good resistance to skidding is to be obtained in a pavement surface when the pavement is wet, the composition of the mix must be sound and the aggregate must be of the kind that will remain rough and resist severe polishing under traffic.

"Road Tests Determine: What Makes Autos Skid?" By H. O. Thompson, Testing Engineer, Mississippi State Highway Dept. *Engineering News-Record*, Feb. 6.

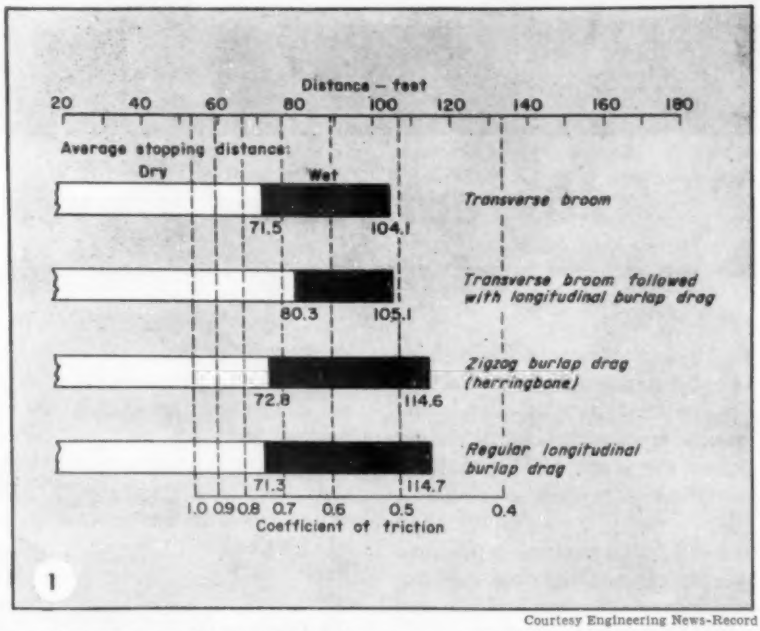
Prestressed Concrete Bridges

The California Highway Department has built 65 prestressed concrete bridges since 1951. These bridges include channel, T, L, slab and box girder-type of sections. In slightly over half of the prestressed work the prestressing has been done at or near the bridge site by the contractors. At one job 6 sets of wooden forms were constructed with ⅝-in. treated plywood used on exposed surfaces in the construction of T girders. Two girders were cast each day but toward the end of the job when the crews became more efficient, they were able to cast a maximum of 12 girders per 5-day week. Standard sections have been prepared by the Bridge Design Section for slab, girder, and I-type precast prestressed units. Span length for the slab units are from 19 through 40 ft., slab girder units from 30 through 60 ft., and I-girder units from 30 through 120 ft. Wire or strand is specified to have an ultimate tensile strength of not less than 200,000 psi and alloy bars not less than 145,000 psi. Stress-relieved wire with an E of not less than 24,000,000 at 70 percent of the manufacturer's minimum guaranteed ultimate strength is specified. Bars are required to be proof-stressed to at least 90 percent of the specified minimum tensile strength. Conventional structural concrete is designed for a minimum strength of 3500 psi, a standard 6-sack mix with low alkali. The strength of concrete ranges from 3500 to 5500 psi and steam curing is generally used. Slab type structures ranged from $6.86 to $7.26 psf of superstructure and from $12.76 to $12.84 psf for the entire bridge. I-girders ranged in cost from $6 to $9.77 psf of superstructure and from $9.54 to $18.32 psf for the entire bridge.

"Experience Gained on 65 Prestressed Concrete Bridges." By I. O. Jahlstrom, Principal Bridge Engineer—Operations, California Division of Highways. PUBLIC WORKS, March, 1958.

Electronic Devices For the Civil Engineering Field

This is a series of short articles that familiarizes engineers in the public works field with the widespread applications of electronic equipment for the solution of problems in highway planning and design, in hydraulics and hydrology and in photo-grammetry computations. Several types of electronic computers, new electronic devices used for surveying and data plotting, and the services offered by firms specializing in the analysis of data through the use of electronic computers and related devices are described. Although these machines are already in use by state highway departments, the Bureau of Public Roads, consulting engineers and large contractors, it is felt that their application in the field of civil en-



Courtesy Engineering News-Record

● **SKID TESTS: Relative stopping distances, at 40 miles per hour, on Portland cement concrete surfaces having various finishes, as indicated, both day and night.**

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gineering has barely been touched.

"Electronic Devices for the Civil Engineering Field." PUBLIC WORKS, March, 1958.

Getting the Most Out of Photogrammetry

Aerial photography is now a "must" in the everyday operation in the Michigan State Highway Dept. Complete photographic (stereoscopic) coverage of the entire state at scales of 3 and 4 ins. to the mile, with several isolated sections at about 2,000-ft. to the inch are on file. The most practical photo scale for the preliminary work is 800 ft. to the inch. For the study of certain types of grade separations in heavily built-up areas, surveys at 200 ft. to the inch with enlargements up to 40 and 50 ft. to the inch have been used. The print assemblies are made in the form of stapled mosaics, without any control other than what can be inserted through the use of what is called "straight-line method" for orientation. It makes no difference how big these mosaics are for the copy camera can make negatives up to 40 ins. square and there are facilities for copying individual mosaic boards up to 4 ft. x 8 ft.

Before the special aerial photographic flight, a survey party on the ground will establish the preliminary line shown on the mosaic blueprint. They may or may not stake out the centerline, but by measurement they will set P.I. points and establish points along the centerline from 1200 to 1500 ft. apart. Each one of these points is then carefully flagged with two 8-ft. strips of heavy 18-in. building paper crossed and centered at the centerline stake. After the aerial photographs are obtained, the location of the desired vertical control is shown on a set of the contact prints which are given to a survey party for the subsequent field work. Also a set of the same photographic enlargements is given to the soils engineers. The final product is a topographic map at a scale of 1 in. = 100 ft., with a 2-ft. contour interval.

"Getting the Most Out of Photogrammetry." By C. A. Weber, Deputy Commissioner and Chief Engineer, and John E. Meyer, Route Location Engineer, Michigan State Highway Dept. *Civil Engineering*, February, 1958.

Problems of a County Engineer

In 1937, the WPA straightened the channel and built a 32-ft. long wooden bridge to replace the original 20-ft. span across a gulley in Saline County, Nebraska. Since that time, periodic additions have expanded the bridge length until last year the span across the gully totaled 110 ft. When the gulley had again widened, it was decided to use a 96-in. diameter Armco multiplate culvert and an earth embankment. The gully drains 480 acres and is normally dry, but in a heavy rainfall, a good stream of water comes down it. The new installation provides a 100-ft. long culvert incorporating a soil-saver elbow. After the culvert was assembled, the old bridge was removed and a 20-ft. high fill constructed to carry the road. The lumber from the old bridge, worth approximately $3500, was salvaged for other uses.

"Problems of a County Engineer." By Carl Engel, County Engineer, Saline County, Nebraska. *Highway Magazine*, February, 1958.

Electronic Computing of Highway Quantities

Electronic computing methods are being used by the Ontario Dept. of Highways in its earth-quantity calculation program. Every computing process is based on 3 sets of infor-

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mation: input information, output information and the procedures, formula or equations for arriving at the latter. The input information for the program consists of cross-section notes, template description, and vertical curve information. The output information consists of details of vertical curves, centerline elevations of the projected highway, coordinates of the slope stake points, cross-sectional areas and volumes of the various quantities. Calculation procedure involves applying formulas of analytical geometry to compute coordinates of intersection points, distances, slopes, areas and volumes. A highway project is initiated by the planning division, based on an analysis of traffic and other data. The horizontal alinement is decided upon and field survey parties make cross-section measurements, and the resulting notes are punched into cards for input to the computer. The planning section plots a ground profile along the line of the highway and from this the design engineer decides on the grades and vertical curves. The percent grade of each tangent, and the curve length or rate of change of grade of each curve, are punched into a separate deck of cards called the vertical curve deck. Meanwhile from soils data and highway specifications, template data are prepared and punched into cards. The 3 decks of cards are fed into the computer under separate programs and vertical curve data, cross-section and highway elevations, cross-section areas and quantity volumes are calculated by the device.

"Electronic Computing of Highway Quantities." By Dr. Josef Kates, President, KCS Data Control Ltd., Toronto. *Roads and Engineering Construction*, January, 1958.

Revolving Fund Financing System Helps Pave Streets

The citizens of Ferguson, Mo., approved a proposal to issue bonds totaling $200,000 to finance a revolving fund to pay for public improvements for which special assessments are issued. The street program will be built over a 5-year period with 23 miles of streets being paved. The $200,000 acts as a municipal bank account from which funds are drawn to pay contractors. The city, in turn, issues special assessments against property abutting the newly paved street. These special tax bills carry an annual interest rate of 8 percent, and are payable in 7 years. However, the property owners may settle the bill in 30 days and avoid interest payment. By using financing of this type contract prices are 25 percent less than using special assessment tax bills to pay contractors. Bid prices for 6-in. concrete pavement have been $3.40 psy and $3.65 psy for 7-in. pavement. To further expedite the work and help reduce costs, street department crews grade the streets for paving and also handle backfilling and backsloping work, including driveways.

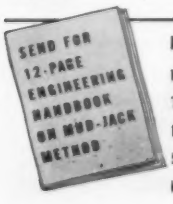
"Revolving Fund Financing System Helps Ferguson Pave Streets." By Robert C. Storey, City Manager, Ferguson, Mo. *The American City*, February, 1958.

Tar Rubber Concrete Apron

This flexible pavement aircraft parking apron at Williams Air Force Base, Arizona, was constructed in the shape of a trapezoid which totals 104,200 sq. yd. Constructed in 2 stages, the first stage consisted of a compacted 6-in. native soil as a subgrade, 9-in. imported, select material for the subbase course, an asphalt prime coat, 1½-ins. of asphaltic concrete for the binder course, and 1½ ins. of asphaltic con-

How Mud-Jack® *stabilizes sub-grades*

Here is an easy, low-cost way to raise settled sidewalks, street slabs, curbs, gutters, driveways. Koehring Mud-Jack pumps soil-cement slurry under pressure into small holes drilled through pavement. This displaces air pockets, water or water-saturated materials, raises the concrete slab, leaves firm permanent sub-grade. Two sizes: compact, portable No. 10 for cities, and the big No. 50 Mud-Jack for preventive maintenance and low-cost repairs on highways.



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Hyde and Cook's K-45 Kompactor* boosts daily compaction on 10-million cu. yd. job!

Few contractors ever have the compaction problem that faced Hyde Construction Co. and Cook Construction Co. when they started a $4-million naval air station job in July, 1957. The joint-venture contract called for approximately 10-million cu. yds. of earthwork just north of Meridian, Miss.

First, density specifications were rigid. Second, the soil was wet and predominantly sand, with some clay. Third, the contract permitted 360 calendar days for completion, with $500-a-day penalty clause—and normally *only about 180 days a year can be worked in the area!*

With a vast array of conventional compaction equipment, the contractors were able to average 50,000 yards a day. This meant at least 200 working days would be required.

By mid-September, however, compaction had been increased to 65,000 yards a day—thanks, in a large part, to a Buffalo-Springfield® K-45 Kompactor roller put on the job.

Boosting production and meeting rigid specifications is nothing new for the self-propelled K-45 Kompactor . . . and here's why:

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The Buffalo-Springfield K-45 Kompactor has proved itself as the top performer, the top money-maker for leading contractors throughout the country. Airfields, superhighways, military establishments—wherever the job is tough, specifications hard to meet and time short, you can count on the K-45 to do the job better . . . faster . . . *and at the lowest possible cost!*

See your Buffalo-Springfield Distributor today and get all the facts about the unusual Buffalo-Springfield K-45 Kompactor.

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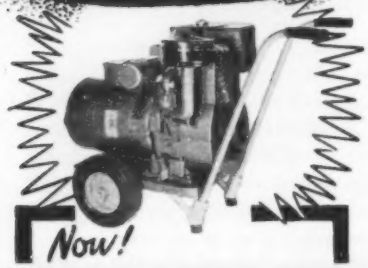

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crete for the surface course. The second stage of construction consisted of a 1½-in. tar-rubber concrete surface course applied to the above pavement. The cracks were cleaned and sealed and all areas covered by oil and grease were cleaned with a detergent before coating. The seal coat consisted of a sand-coat-tar-pitch emulsion slurry and was applied by a spray type applicator in three coats. The first coat consisted of 0.1 gal psy of straight emulsion applied to the surface immediately after it had been dampened with 0.1 gal psy of water. The water was sprayed at 100 psi and the emulsion at 125 psi. The second coat consisted of a slurry of 10 lb. of sand per gallon of emulsion. It was applied at 0.1 gal psy plus the sand content of the slurry, at a pressure range of 10 to 25 psi. After the second coat, joints and cracks remaining unfilled were filled flush with the pavement surface with the same slurry mixture, applied by hand squeegees. The third coat was exactly like the second.

"Tar Rubber Concrete Apron and Its Surface Treatment by New Slurry Method." By William O. Harrell, Civil Engineer, San Antonio, Texas. *Roads and Streets,* February, 1958.

Welded Aluminum Bridge

A welded aluminum highway bridge will be completed this summer in Des Moines, Iowa. The bridge will contain about 75,000 lbs. of structural aluminum and 4300 lbs. of aluminum handrail. The 220-ft. long structure will carry an existing two-lane road over a new section of four-lane divided interstate route. Span lengths are two at 41.25 ft. and two at 68.75 ft. There are four lines of welded aluminum girders spaced 9.5 ft. c-c beneath an 8-in. reinforced concrete roadway slab. The girders are connected together with continuous transverse aluminum beam diaphragms at the piers and abutments and at 13-ft. 9-in. intervals in between to equalize deflections. A sufficient minimum amount of longitudinal reinforcing steel is provided for the full lengths of the concrete slab to prevent the girders from pulling the slab in two when the temperature rises. The girders are to be fabricated by welding 3 plates together to form an I-section. The flange plates are to be welded to the web plate with continuous 5/16-in. fillet welds. These welds can be made at an estimated rate of 9-ins. per min., and at an actual cost of about 50¢ per ft. of weld.

"Iowa Tries a Welded Aluminum Bridge." By Ned L. Ashton, Consulting Engineer, Iowa City, Ia. *Engineering News-Record,* February 20, 1958.

Other Articles

"A Survey of Air Pressures of Tires Mounted on Trucks Operating in the Everyday Traffic." By Carl C. Saal, Chief Vehicle Operations Branch, Bureau of Public Roads. Public Roads, February, 1958.

"Corrugations on Earth and Gravel Roads, Their Formation, Treatment and Prevention." By J. S. Tanner, BSc, Colonial Section, Road Research Laboratory. Roads and Road Construction, January, 1958.

"The County Surveyor, Then and Now." By Guy E. Neeper, Lucas County Engineer, Toledo, Ohio. Public Works, March, 1958.

"Aerial Photography is a **Low Cost Aid for Tax Equalization."** A county uses modern tools for tax work. By S. H. Christopher, Tax Engineer, Whitfield County, Dalton, Ga. Public Works, March, 1958.

"County Road Stabilization with Calcium Chloride." Crushed slate used with calcium chloride. By Louis J. Waldenberger, County Highways Engineer, Bel Air, Maryland. Public Works, March, 1958.

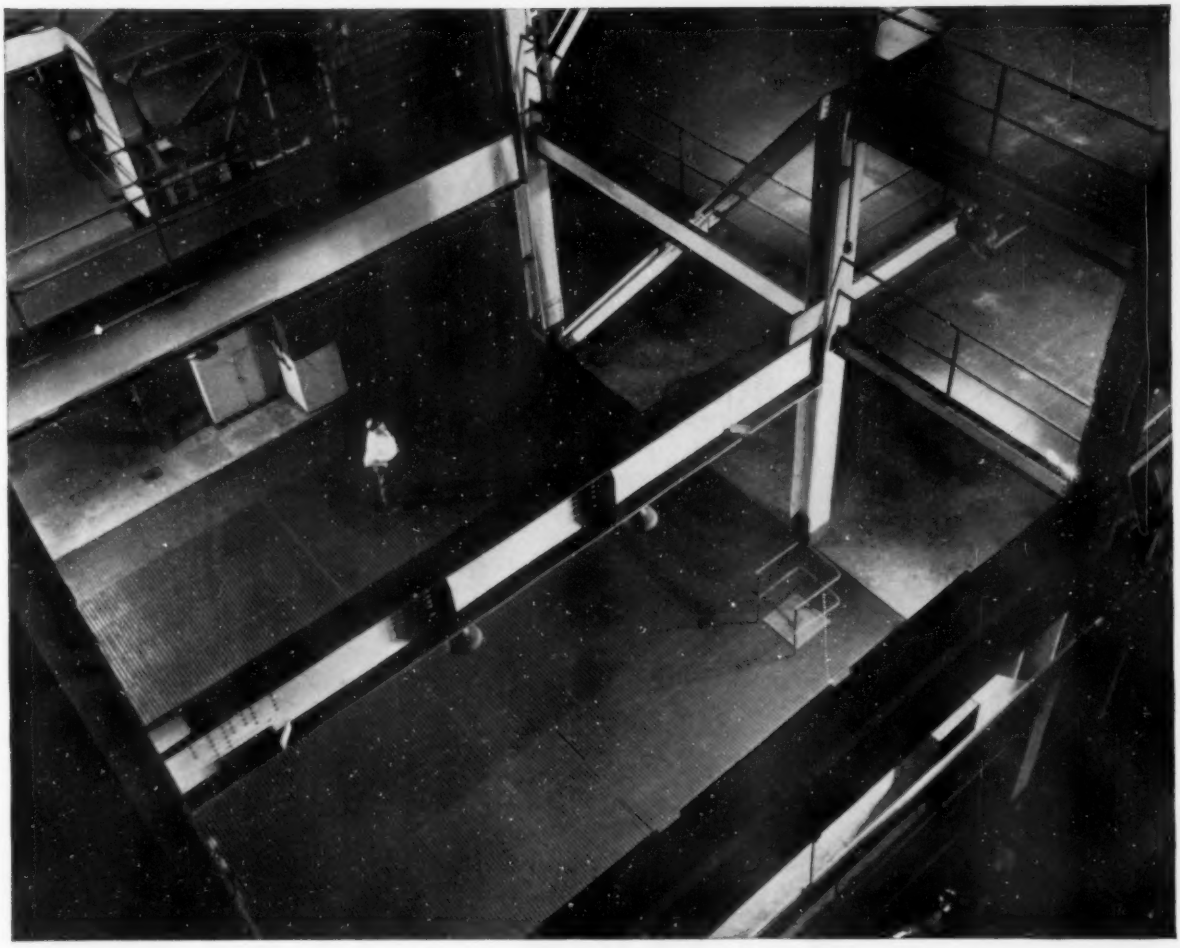
"Portable Units Do Stationary Job." Details of an assembly of rubber-tired aggregate production units designed specially for simultaneously converting the run of a boulder-strewn glacial pit into concrete sand and stone and material for armored shoulders. Roads and Streets, February, 1958.

"Rail Post Testing." Texas Highway Department has several tests for aluminum and malleable iron cast posts for bridge railing. By Farland Bundy, Senior Design Engineer, Bridge Div., Texas Highway Dept. Texas Highways, January, 1958.

"An Up-to-Date Traffic-Signing Program Is Worth Cost." About 4 years ago, Tulare County, Calif., found most of its signs inadequate. New signing system has resulted in decline in county's traffic-accident rate. By Joe Garcia, Jr., County Road Commissioner Tulare County, Calif. Better Roads, February, 1958.

"Concrete and Cement Mortar Additives." Various additives are used to modify the consistency, setting time or final composition of concrete and cement mortar. This article outlines additives employed and the improvements they achieve. By J. Singleton-Green and P. L. Critchell. Contractors Record and Municipal Engineering, February 5, 1958.

"Reconstruction of Fosse Way in Leicestershire." **Machine laid concrete work** by direct labor on two miles of A46 at Narborough. The Surveyor and Municipal and County Engineer, February 1, 1958.



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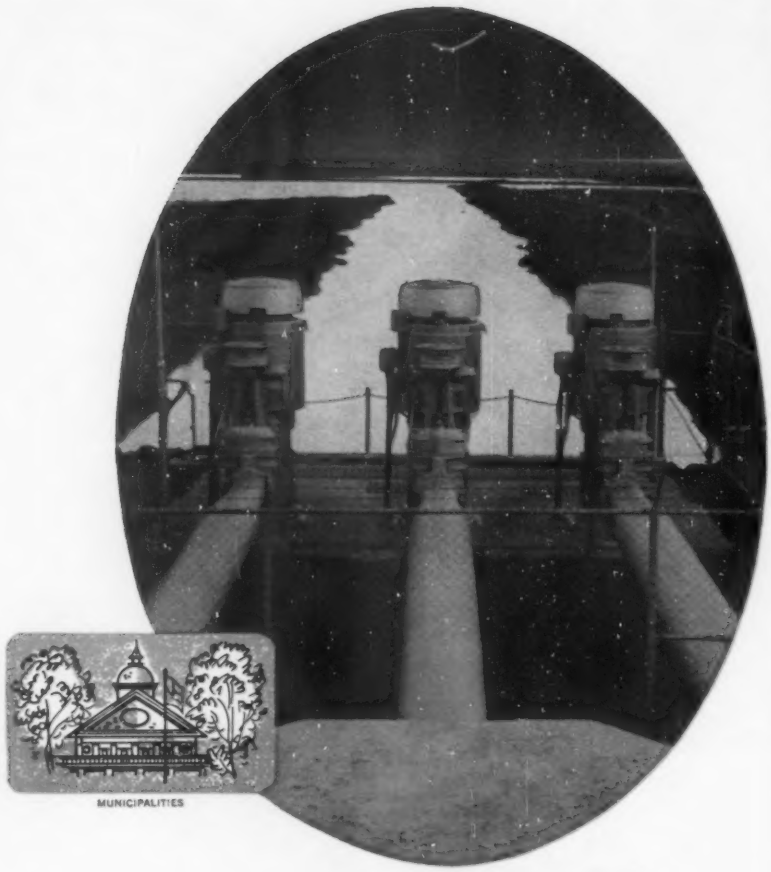

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Conservation Farmers Protect Pennsylvania Roads

Farmers practicing conservation save taxpayers close to $500 a mile annually in costs of maintaining Pennsylvania roads, according to U. S. Soil Conservation Service state headquarters at Harrisburg. The saving was noted in a report issued by the York County Highway Department after a study of two similar stretches of roads in the county which are subject to annual sediment and erosion damage.

Costs of removing mud, and repairing roadbanks and culverts along an ordinary mile of road through rural land average $512. By contrast, the cost of maintaining a mile through York County's soil conservation farms was only $39.

Savings were attributed directly to the work of the conservation farmers who keep their slopes under grass and woody cover and generally have planned water disposal systems. In this way, many of York's 1,879 soil conservation district cooperators prevent runaway soil and water from impairing nearby roadways.

Snow Removal Funds Allotted

Disbursement of $519,366.70 in snow removal funds to Michigan counties which had 70 or more inches of snow during the 1956-57 winter season has been announced by the Michigan State Highway Department.

The distribution is based on the number of "inch miles of snowfall" in each of the counties recording over 70 inches of snow. The reimbursement formula multiplies the number of inches of snow by the number of miles of road in the county road system.

Twenty-three counties will share in the funds. Houghton county will receive the largest amount of any county, its share of the fund being $109,385.22.

Distribution of snow removal funds is provided for in Act 262 of the Public Acts of 1957, which amended and supplemented Act 51 of Public Acts of 1951. The new law provides that an amount equal to 0.8 percent of the total amount returned to the several county road commissions from the Motor Vehicle Highway Fund during the prior calendar year shall annually be withheld from the counties' second quarterly distribution, and the amount shall thereafter be returned to the several county road commissions for snow removal purposes.

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PUBLIC WORKS DIGESTS

Prepared by
ALVIN R. JACOBSON, Ph.D.
Associate Professor and Head,
Division of Sanitary Science,
Columbia University School of Public Health

THE SEWERAGE AND REFUSE DIGEST

A Review of 1957

The author has reviewed the progress of the past year in the interest of evaluating accomplishments and establishing some guide-lines for improving future performance. The problems of higher interest rates, increased water demands and recruitment of qualified personnel were becoming increasingly difficult. Since Public Law 660 went into effect on July 1, 1956, it has been the stream pollution law at the federal level. During the first year of its operation a total of 446 projects were approved and offered federal grants with an estimated construction cost of $166.8 million. Many new sewage treatment facilities, with several new innovations, were placed in operation around the country. Several photos of typical installations and some of these innovations are presented in this article.

"Sewage and Industrial Wastes in 1957." By Kenneth S. Watson. *Water and Sewage Works*, February, 1958.

New Middlesex County Plant

The new Middlesex County, N.J., sewage works system was recently placed in operation by the sewage authority comprising 13 municipalities and 8 industries after a quarter century of discussion and an expenditure of 30.6 million. The system comprised of 27 miles of trunk sewer, interceptor and outfall lines and a modern sewage treatment plant will eliminate the pollution of the Raritan River through the treatment of the 78 mgd average flow of sanitary and industrial wastes from these 21 communities and industries. The plant is designed as a chemical treatment plant. The sewage is prechlorinated and lime is added. Abrasive materials are removed in the grit chambers and copperas is added to the effluent before it is diverted to one or all of the four 130-foot circular Clariflocculators. The clarifier effluent is post-chlorinated before entering the outfall. The sludge is pumped to sludge thickening tanks and the thickened sludge is loaded on barges for final disposal at sea.

"$30.6-Million County Sewage Project Serves 13 Communities, 8 Industries." By Chester A. Lydecker and Sol Seid. *Wastes Engineering*, February, 1958.

Refuse Collection in 35 Cities

The results of this survey of 35 typical cities ranging in population from 134,000 to 51,000 indicate that 390 packer-type collection units were in use, ranging from 33.7 units per 100,000 population to 3.0, with a mean of 16.7. The use of packer-type units reduced personnel requirements in most instances, usually from 4 men per open truck to 2 men per packer-type unit. Estimates of savings in personnel and time ranged widely from little or no savings to 50 percent. Other advantages were improved sanitation, more material per load, fewer trips to unloading site, greater ease in loading and unloading and fewer injuries to loading personnel. The cleansing of trucks varied widely, i.e., water alone, water and soap, water and detergent, water under pressure, and steam under pressure. The application of chemicals for odor control, including masking and counteracting agents, to the collection vehicles was indicated in some cities. These chemicals and insecticides were applied to the disposal sites in other cities. The information in this article supplements data on the economies and practices of refuse collection with packer-type vehicles which was published in the January 1958 issue of PUBLIC WORKS.

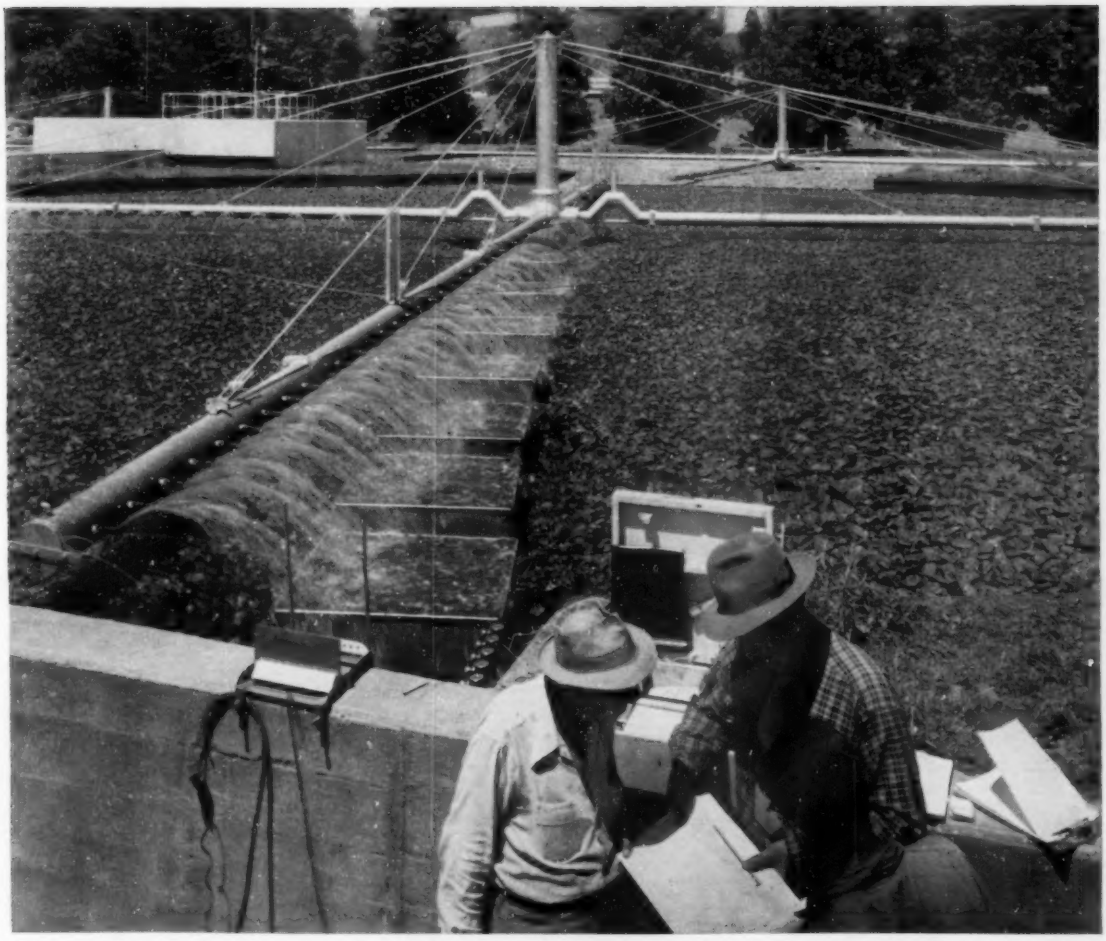
"Refuse Collection Methods and Equipment." PUBLIC WORKS, March, 1958.

"Not a Drop Wasted"

The City of Ephrata, Washington, is located in the north central portion of the United States Bureau of Reclamation's Columbia River Basin Irrigation project where water is difficult to obtain. This community has grown from a population of 1,873 in 1945 to over 7,100 in 1956 and will continue to grow. The irrigation project which will be completed in about 10 years, will have a potential of over 1,000,000 irrigated acres. The absence of watercourses in this area made it necessary for all sewage effluent from the primary sewage treatment

Courtesy Olney Borden, P.E.

● **HIGH RATE trickling filter at Liberty, N. Y., kept operating despite snowfall of 35 inches and sub-zero weather for several days. Average was 11 degrees below.**



Pan Tests being conducted on one of the 113' P.F.T. Distributors at Greenville, S.C. These tests show high uniformity of distribution over the entire range of flows—from 400 to 2100 gpm.

Proven uniformity of distribution with P.F.T. Rotary Distributors

Ten new P.F.T. Rotary Distributors have recently been installed in the Greenville, S.C. sewage disposal plant to increase the capacity of the existing filters. Six are 113 foot units and four are 136 feet in diameter.

All ten Distributors are equipped with P.F.T. automatic low-loss overflows on the two secondary arms. These overflows permit two arm-four arm operation and assure uniform distribution over the wide ranges of flow with a minimum of head.

These P.F.T. Distributors, with proven uniformity of distribution, are the heart of Greenville's expanded new treatment plant.

Plant addition by Wiedman and Singleton, Consulting Engineers, Atlanta.

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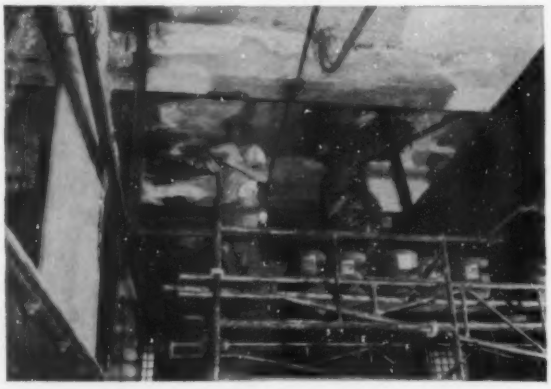
Workmen prepare old surface for patching with THORITE.

Water has entered the concrete and caused corrosion of reinforcing rods, blistering the concrete off surface and causing structural weakness throughout building.



Reinforcing was cleaned, all corrosion was removed and brush coat of THORITE applied over entire patching area, then filled in with trowel coats of THORITE, even with surrounding surfaces.

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plant constructed in 1948 to be disposed in a leaching pool. This 0.5 mgd plant also consisted of a primary clarifier and primary and secondary digesters. In 1955 an enlarged plant of 2.0 mgd capacity and 4.0 mgd maximum flow was designed and constructed, using primary settling followed by lagooning of the effluent. The design of the lagoon is based on a maximum loading of 75 pounds of BOD per acre per day although the present loading approximates 30 pounds/acre/day. The lagoon effluent is used for the irrigation of 80 acres of farmland, which is sanctioned by the Washington State Department of Health. The sludge is digested in a primary and two secondary digestion units, dried on open beds and then used as a soil conditioner on local parks and private residences.

"Not A Drop Wasted." By William E. Johnson. *The American City*, February, 1958.

Sludge Digestion Studies

This article is a report of an investigation of the relationship between volatile acids concentration and the rate of gas production in sludge digestion. This laboratory study was accomplished by setting up a series of digesters with known capacities for converting volatile acids, i.e., acetic, proprionic, and butyric acids, to methane. By increasing the feeding rate of the volatile acids in a controlled manner the effect on gas production was measured. The results of this study indicate that the same relationship between volatile acids concentration and gas production holds for all three organic acids. Gas rates decreased below the optimum level when volatile acids concentration increased beyond a critical level although the absolute value of the critical limit varied considerably according to conditions such as pH, and the cations present. The experimental results agree with the general concept of anaerobic digestion being a balanced process where the raw material is continually broken down to organic acids by one group of micro-organisms, and the organic acids in turn being converted into methane and carbon dioxide by a second group of micro-organisms, the methane bacteria. The balance is kept in favor of methane fermentation by maintaining proper temperature, pH and controlled feed rates, the latter being the most important factor. For continuous operation the concept of a critical volatile acids con-

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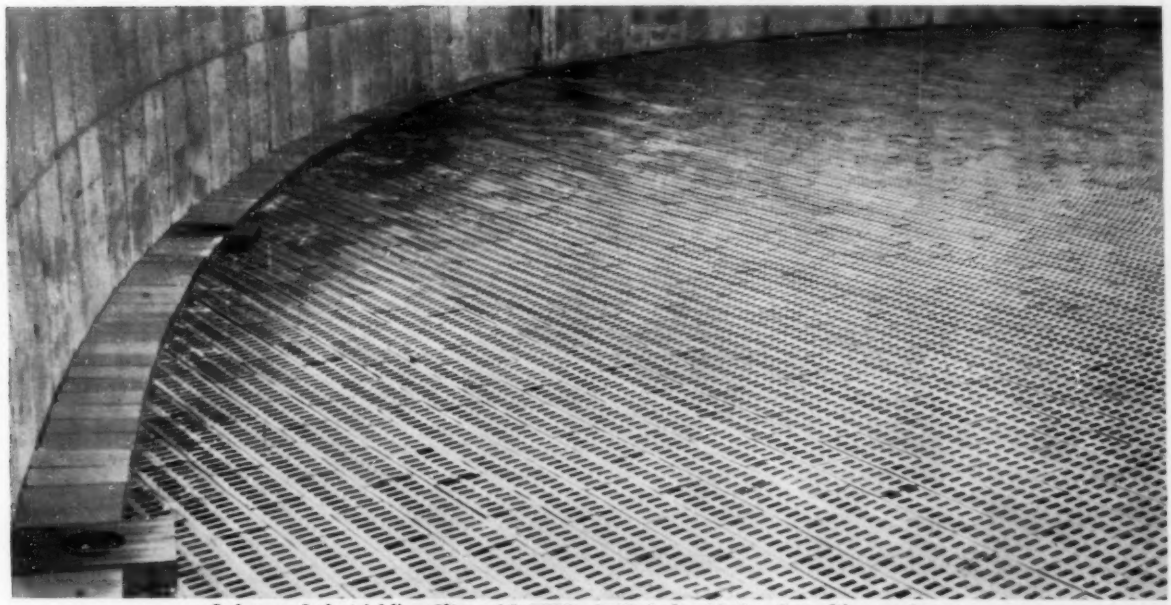
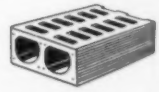
Address any members of the Institute listed below for FULL details and suggested specifications.



Lebanon, Ind., trickling filter with TFFI vitrified clay blocks. Consulting engineers, Paul J. Kleiser & Associates; contractors, C & C Construction Co., Fort Wayne, Ind.



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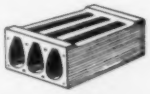

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TFFI — Symbol of good treatment

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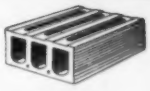


POMONA
Pomona Terra-Cotta Co.
Pomona, No. Car.

TRANSLOT
Connelton Sewer Pipe Co.
Connelton, Ind.

BOSCO
Bowerston Shale Co.
Bowerston, Ohio

centration at about 3,000 ppm seems to be valid.

"Studies on Sludge Digestion and Methane Fermentation." II. Methane Fermentation of Organic Acids. By K. L. Schulze and B. Naga Raju. *S. & I.W.*, February, 1958.

Biochemical Degradation Products

This article is a report of a study of the oxidation of certain organic compounds by acclimated activated sludges aimed at determining the nature of the suspected end products. On the basis of a review of present literature on this subject and of the experimental results of the present study, the following conclusions are drawn: 1) Organic stream pollutants generally cannot be evaluated adequately in terms of BOD and COD alone. Neither test allows description of residual organics which may be present after varying periods of biochemical oxidation; 2) Biochemical degradation intermediates or by-products have been demonstrated during the breakdown of oils and alkyl benzene sulfonates; 3) Oxidation of an organic compound may be related to a portion only of the original molecule, i.e., the portion most easily oxidized; 4) Many consecutive enzyme reactions may be involved in the degradation of an organic compound.

"Biochemical Degradation Products-A New Dimension in Stream Pollution." By R. H. Bogan. *S & I.W.*, February, 1958.

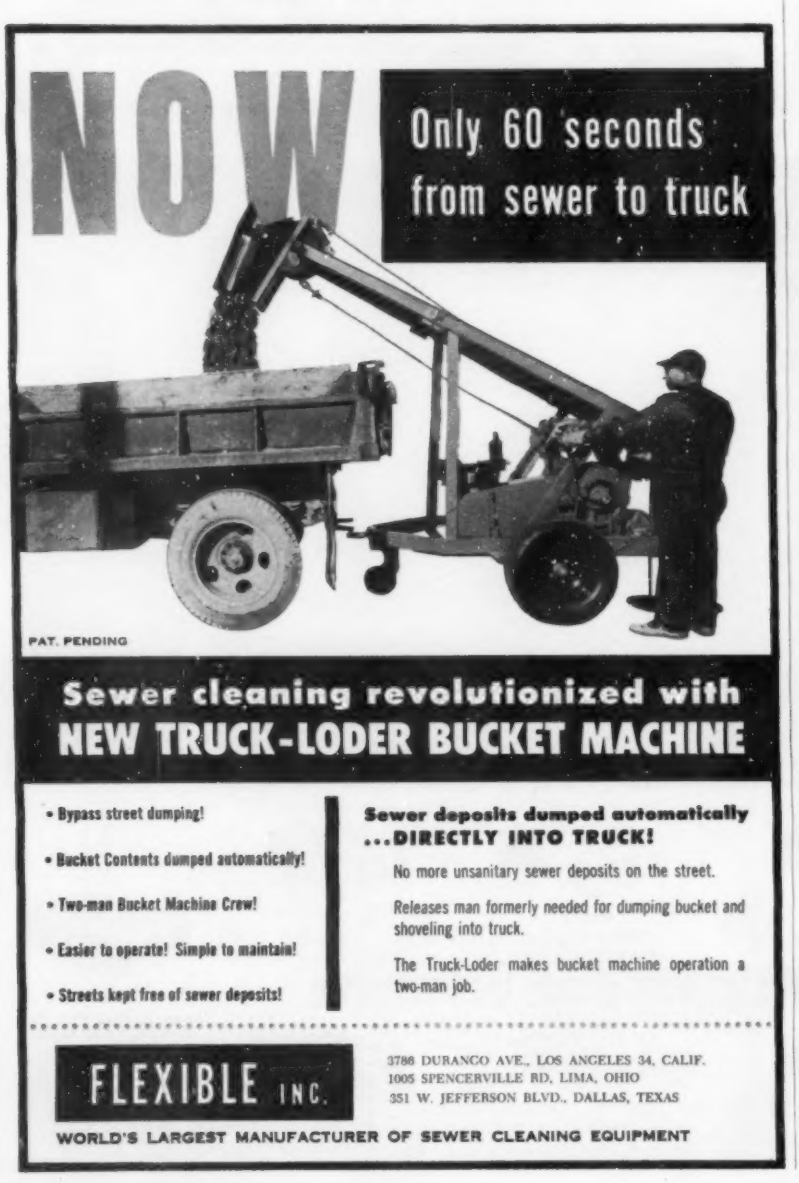
Landfill in Frankfurt, Germany

Frankfurt's City Cleansing Department operates in four sections covering refuse collection, street cleaning, general transport and public conveniences. This city of 660,000 persons is divided into 50 refuse collection areas, each supplied with a vehicle and driver and five other men with a supervisor for every eight to ten vehicles. Fifteen other men and five other vehicles are used solely for collections from industrial and commercial establishments. Enclosed trucks costing $18,000 each are used for refuse collection. Five sets of spare parts for every vehicle are kept in the storeroom, representing an inventory of $75,000. Another interesting item is the drivers' school to which every new driver must attend. In 1957, the Department owned about 96,000 refuse containers of 25-gallon capacity which were kept maintained and repaired in excellent condition extending the container life up to 20 years at a labor and maintenance cost of approximately $2. All containers must be placed near the front of the premises to reduce carrying distances to a minimum. The collection system compares favorably with cities of similar size in the United States, but the disposal facilities are substandard from the standpoint of sanitation. The open dump is constantly on fire so as to require a well-organized fire-fighting service and equipment. Obsolete salvage equipment will soon be replaced with new modern equipment capable of handling 500 tons of refuse per day. Incineration is also being considered for final disposal.

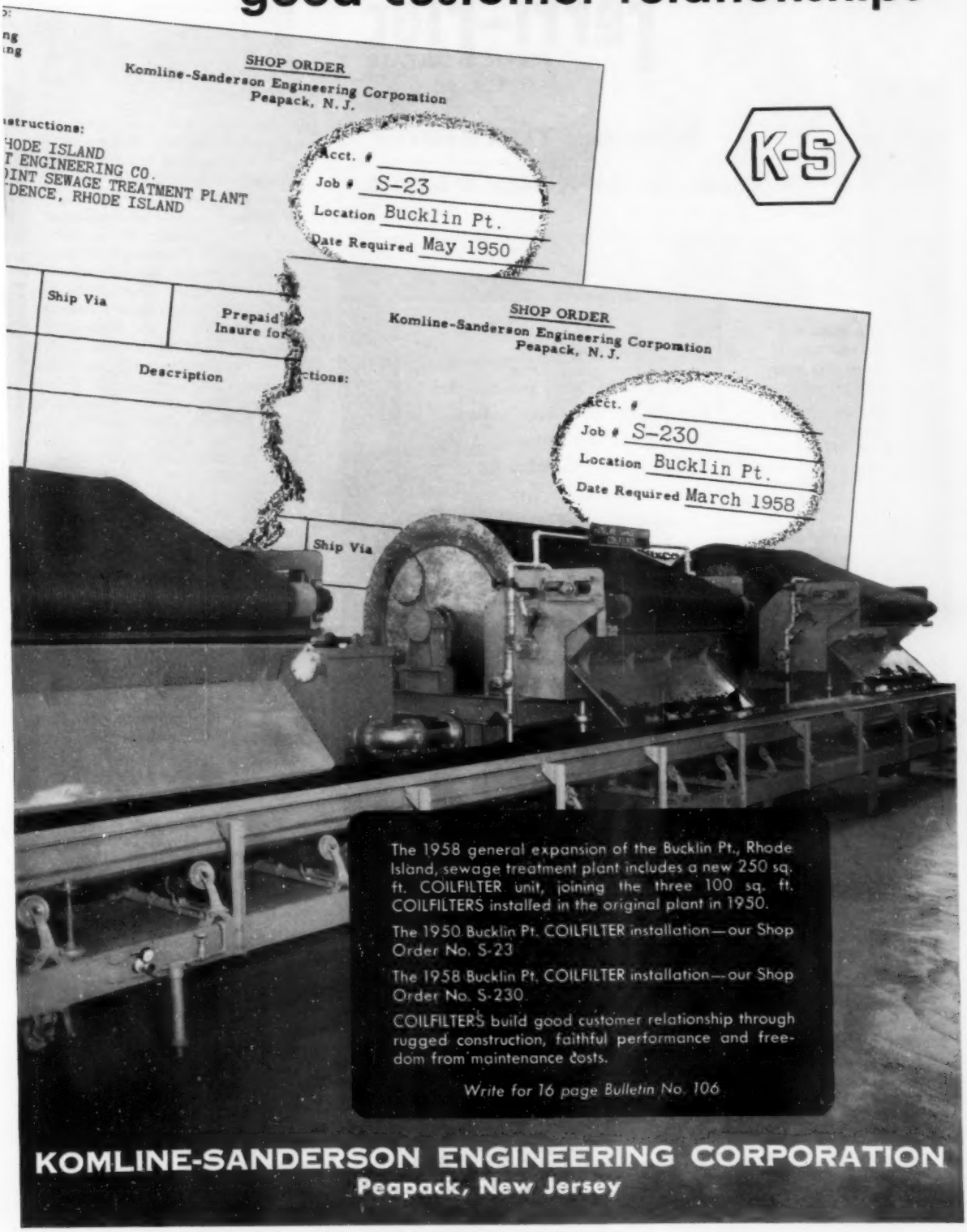
"Sanitation Operations in Frankfurt, Germany." By A. G. Davies. *The American City*, February, 1958.

"Sewer Design Guides"

Sewer design is based upon careful study of local conditions and the application of sound engineering judgment to assure a long, useful life for the sewers. They will be buried under six feet or more of earth and therefore are not subject to frequent inspection as with equip-


NOW
Only 60 seconds from sewer to truck
PAT. PENDING
Sewer cleaning revolutionized with
NEW TRUCK-LODER BUCKET MACHINE
• Bypass street dumping!
• Bucket Contents dumped automatically!
• Two-man Bucket Machine Crew!
• Easier to operate! Simple to maintain!
• Streets kept free of sewer deposits!
Sewer deposits dumped automatically ...DIRECTLY INTO TRUCK!
No more unsanitary sewer deposits on the street.
Releases man formerly needed for dumping bucket and shoveling into truck.
The Truck-Loder makes bucket machine operation a two-man job.
FLEXIBLE INC.
3786 DURANGO AVE., LOS ANGELES 34, CALIF.
1005 SPENCERVILLE RD, LIMA, OHIO
351 W. JEFFERSON BLVD., DALLAS, TEXAS
WORLD'S LARGEST MANUFACTURER OF SEWER CLEANING EQUIPMENT

Repeat orders are the test... COILFILTER builds good customer relationships



The 1958 general expansion of the Bucklin Pt., Rhode Island, sewage treatment plant includes a new 250 sq. ft. COILFILTER unit, joining the three 100 sq. ft. COILFILTERS installed in the original plant in 1950.

The 1950 Bucklin Pt. COILFILTER installation—our Shop Order No. S-23

The 1958 Bucklin Pt. COILFILTER installation—our Shop Order No. S-230

COILFILTERS build good customer relationship through rugged construction, faithful performance and freedom from maintenance costs.

Write for 16 page Bulletin No. 106

KOMLINE-SANDERSON ENGINEERING CORPORATION
Peapack, New Jersey

TENNESSEE CORPORATION

Ferri-Floc
FERRIC SULFATE

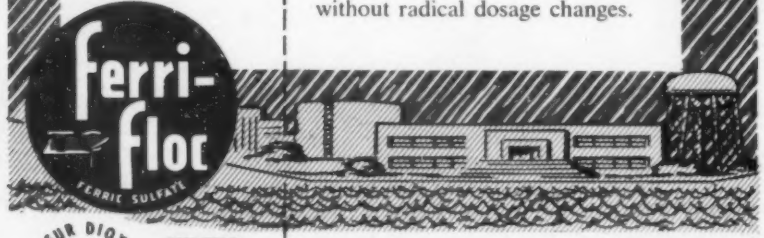
For Reducing **TURBIDITY**

Caused By **SPRING RAINS**

The Superior COAGULANT With The Plus FACTORS—

- Excellent taste and odor control
- Increased filter runs
- Coagulation over wide pH ranges
- Rapid floc formation
- Economy
- Turbidity removal
- Color removal
- Manganese and Silical removal
- Bacteria removal
- Ease of Operation

Ferric salts have proven their ability to coagulate waters of widely varying turbidity. Spring rains increase turbidity for those who must treat surface supplies. The use of Ferri-Floc will simplify the treatment of this high turbidity. Ferri-Floc is partially hydrated Ferric Sulfate that has the ability to convert these high turbidities without radical dosage changes.



SULFUR DIOXIDE — SO_2 — SULFUR DIOXIDE

Sulfur-Dioxide is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

Copper Sulfate will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

FREE BOOKLET

Let us send you without charge, a 38 page booklet that deals specifically with all phases of coagulation — just send us a postal card.

WATER TREATMENT

Efficient coagulation of surface or well waters. Aids taste and odor control—Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial waters.

SEWAGE TREATMENT

Ferri-Floc coagulates water and wastes over wide pH ranges—it provides efficient operation regardless of rapid variations of raw sewage and is effective conditioning sludge prior to vacuum filtration or drying on sand beds.

TENNESSEE CORPORATION

617-29 Grant Building, Atlanta, Georgia

ment. The author has discussed the many essential factors of good design, together with many others frequently overlooked.

"Sewer Design Guides That Occasionally Are Overlooked." By Ellsworth L. Filby. *The American City*, February, 1958.

Westport's Landfill Tea Party

An unusual, but effective, method of convincing the citizens of Westport, Conn., that the operating and sanitary conditions of their landfill were effective in eliminating odors and other unesthetic conditions was used last October by inviting the residents to a community tea party at the sanitary landfill. About 500 citizens attended. This rather drastic measure was necessary because of the objections of the citizens to this type of operation. It was necessary to convince them that a landfill could be operated entirely without odor because the present site was almost filled and new sites must be found. During the warm summer months an odor counteractant was used every day, being applied by means of a Copeland air compressor powered by a Briggs and Stratton engine, and a spray device, all mounted on the rear of a tractor. The Airkem spray is sprayed into the air or directly onto the material in the landfill at concentrations dependent upon the weather and odor conditions. The procedure seems very effective resulting in no odor complaints to date.

"Westport Tea Party Boosts Sanitary Landfill Popularity." By Robert A. Hay. *The American City*, February, 1958.

Other Articles

"Conveying **Flowable Materials.**" By Lyne S. Metcalf. Water and Sewage Works, February, 1958.

"**Report From Abroad.**" The Institute of Sewage Purification. By John Finch. Water and Sewage Works, February, 1958.

"We Reduce Cost and **Improve Refuse Collection** with Larger Bodies." By Carl C. Fagerlind. Public Works, March, 1958.

"Pressure **Screen for Sewage Effluent** Keeps Sprinklers Clean." By Dale Wilson and Norman A. Neste. Public Works, March, 1958.

"**Sewage Plant for Restaurant** Treats 12,000 G.P.D." Public Works, March, 1958.

"Space **Frames Cover Trickling Filter.**" Public Works, March, 1958.

"Sewage **Sludge Thickening** by Mechanical Vibration." By Guenter Spohr and W. Wesley Eckenfelder, Jr. Public Works, March, 1958.

ARE YOU UP-TO-DATE ON FLOCCULATORS?

THIS NEW BOOKLET HAS THE FACTS!

If you're interested in flocculation equipment...for water, sewage or industrial waste treatment...you need this new fact-packed Bulletin No. 315-51. It describes the Rex line of flocculating equipment to suit all conditions...where there are *no* floating solids...where there *are* floating solids...and for parallel or cross flow arrangements.

Bulletin 315-51 gives you the complete story on Rex Floctrol...Slo-Mixer... Cross-Flow Flocculator...Vertical Flocculator...and Flash-Mixer. It clearly shows the advantages of Rex tank designs, and of Rex equipment to help you improve mixing, save chemicals, and increase plant efficiency.

Send for your copy today. Write to your Rex Sales Engineer, or to CHAIN Belt Company, 4722 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT

MUNICIPAL POWER PLANT
PROFITS REDUCE TOWN TAXES

A NEW Fairbanks-Morse opposed-piston diesel burning No. 5 fuel oil has cut fuel costs 27 percent in the municipal power plant at Thayer, Mo., population 1700. Profits from the plant pay a large portion of the expenses of non-revenue departments and keep taxes low.

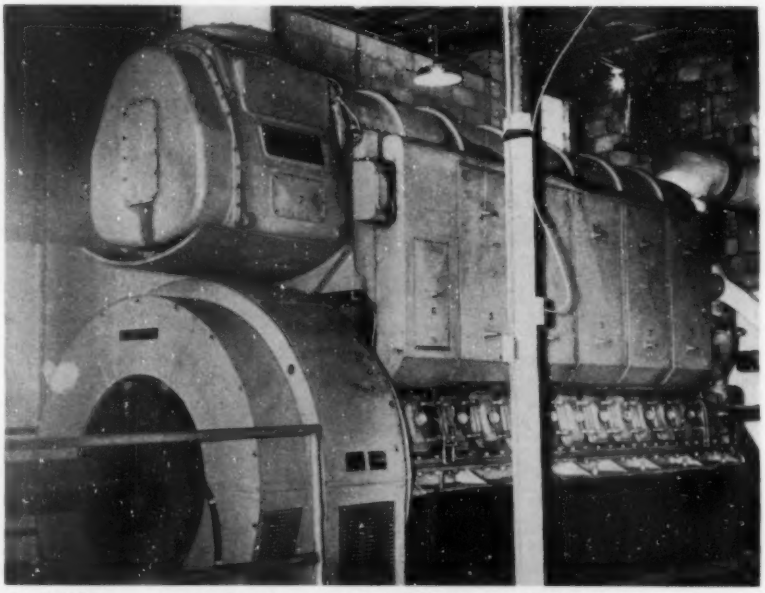
All light and power for Thayer is supplied by the municipal power plant which is equipped with five Fairbanks-Morse diesels and generators totalling 2305 kw. In addition to owning and operating this municipal power plant, the town has combined with it the water works and an ice plant which serves surrounding communities over a radius of 75 miles.

A major purpose in owning and operating these facilities is to make enough profit to help pay operating expenses. Like many little municipalities in the middle west, taxes would have to be high to support needed civic services. If profit is to be made for the town, the plant must be run efficiently and economically, keeping labor and other overhead to a minimum. That is being done under the supervision of S. W. Wooldridge who heads all three departments and operates them as an integrated service.

During the growth of the plant, none of the older engines was removed to make room for new ones for the reason that they were good engines and generators still able to carry their share of the load. The newest and largest engine, installed in 1956, is a 10-cylinder, 1600-hp., F-M, but all engines are used, each taking turns every other day at power generation.

There are four operating engineers, one on each 8-hour shift and one for the swing shift. They look after the power plant, the water works pumps and the ice plant. An extra man is hired during the summer to help with the ice. Although the man on a shift looks after five engines, the water system and the refrigerating plant, everything is clean and shipshape all the time.

Good operating practice was established at the beginning and has been carried out ever since. All of the engines have closed cooling systems and towers to cool the raw water. The oil is by-passed through filters. The engines have attached pumps and standby motor-driven pumps provide emergency service for water and oil.



● **NEWEST engine in the plant is this 1600-hp opposed piston diesel, operating on No. 5 fuel, about 20 percent lower in cost than No. 2, reducing production cost.**

The diesels are overhauled each 8000 hours of operation and when it comes time to work on an engine, one of the engineers comes in on his day off and is paid overtime to help out. This eliminates the use of outside help on maintenance.

This has been a productive and profitable plant for Thayer. In addition to an output of 3,500,000 kilowatt hours by the power plant's diesels, the water pumps delivered 94,594,000 gallons of city water in 1956, and the ice plant put out 6,825 cakes of ice, a total of 1,028 tons for the year.

The electric plant charges nothing for current to run the refrigerating machines, water pumps, or to provide current for street lighting and other town services. Still, the plant made more than $85,000 in 1956.

Operational Data, Gary Sewage Treatment Plant

Suspended solids raw sewage content in 1956, at the Gary, Ind., sewage disposal treatment plant was equivalent to 0.274 pound per capita per day; BOD content was equivalent to 0.207 pound. Gas production was 1.11 cu. ft. per capita and per 4.77 cubic feet per pound of volatile solids added to the digester. Air supply amounted to 0.42 cu. ft. of air per gallon of sewage. Suspended solids reduction was 91.38 percent to 25.3 ppm and BOD reduction 92.0 percent to 11.5 ppm. Cost per million gallons treated, not including bond interest and retirement, was $18.51.

Cost of Refuse Collection and Disposal

During the fiscal year 1956-57, Raleigh, N. C., collected 260,881 cubic yards of garbage and refuse at a cost of $1.26 per cu. yd. This compared to $1.23 per cu. yd. the preceding year.

IT'S NEW / It's from DORR-OLIVER

THE COMPLETREATOR

This D-O CompleTreator unit is serving a recreational facility at Freestone Point, Virginia.

Now . . . for the first time . . . complete sewage treatment for a population equivalent of 150 persons *in a single unit*. The CompleTreator unit consists of a Dorr Duo-Clarigester surrounded by two stages of high rate trickling filters and two recirculation pumps in respective wells. Solidly based on well-known and proven sanitary engineering principles and methods, the CompleTreator has the outstanding advantage of incorporating in a single unit those processes which previously required five separate tanks. Using the two-stage Biofiltration flowsheet with separate sludge digestion, average daily capacity is 15,000 gallons; and where normal domestic sewage is being handled, a treatment efficiency of 90% BOD and suspended solids removal can be realized. The CompleTreator is ideally suited for housing developments, restaurants, service stations, motels, schools, military installations and domestic type wastes from industrial activities.

For additional information on the Dorr-Oliver CompleTreator, write Dorr-Oliver Incorporated, Stamford, Conn., for a copy of Bulletin No. 7315.

CompleTreator is a Trademark of Dorr-Oliver Incorporated

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

PUBLIC WORKS DIGESTS

Prepared by
ALVIN R. JACOBSON, Ph.D
Associate Professor and Head,
Division of Sanitary Science,
Columbia University School of Public Health

THE WATER WORKS DIGEST

Liquid Alum As A Coagulant

Commercial liquid alum should be considered as a coagulant whenever a new water plant is being designed, or an old plant expanded and modernized, as it will reduce coagulant handling and labor costs, will promote plant cleanliness, conserve space, and contribute to employee safety and can be attractive from a financial standpoint if the plant is fairly near one of the 40 liquid alum manufacturing plants. Liquid alum of 8.3 per cent Al_2O_3 is shipped in tank-trucks of 2,000 to 4,000 gallons capacity or in rubber-lined or stainless steel tank cars. It is unloaded into rubber-lined steel tanks or wood, concrete, or steel tanks lined with lead. The piping, valves, pumps, and feeding devices must also be of material resistant to the corrosive coagulant which has a pH of 2.4. Recent installations of 6,000-gallon capacity have varied from $3,500 to $5,000 while double this size have ranged from $8,000 to $12,000 depending upon the locality and other factors.

"Liquid Alum As a Coagulant." By R. W. Ockershausen. *Water and Sewage Works*, February, 1958.

Municipal Water Softening

This article is a comprehensive review of modern municipal water softening practices, including a discussion of how to choose the most appropriate and economical process, i.e., either 1) the zeolite softening process; 2) the lime or lime soda process; or 3) a combination lime zeolite process. This decision is usually based upon the characteristics of the raw water and other considerations. These other considerations include composition of the water and the results required. The amount of soluble compounds of calcium and magnesium determine the hardness. These soluble compounds may be either in the form of carbonates or non-carbonates which determine the amount of lime and soda ash required in the cold lime or lime soda process. The non-carbonates require soda ash for their removal thereby increasing the cost of softening as soda ash is considerably more expensive than lime. In the zeolite process one portion of water is completely softened and then mixed with unsoftened water to obtain the desired hardness, usually 4 to 5 grains per gallon expressed as calcium carbonate, which is equivalent to about 70 to 85 parts per million. The new organic cation exchange materials are rapidly replacing the greensand or mineral zeolite because of their much higher capacities, higher flow rates, and lower salt consumptions for regenerating the exchanger. A discussion is included of several variations in softening procedures that may be considered if iron and manganese are present in the raw water. The problem of high colors due to organic compounds in combination with iron and manganese are also discussed. Several methods of removal of hydrogen sulfide are given.

"Modern Municipal Water Softening Practices." By Eskel Nordell. PUBLIC WORKS, March, 1958.

Artificial Recharge

Artificial recharge of ground water supplies is being practiced in many areas of the country. Some incidental reasons are: 1) the disposal of waste waters; 2) the drainage of low areas and storm water; 3) the impoundment of surface waters and control of flood waters; 4) the irrigation of agricultural lands. None of these practices is of great importance in increasing the availability of ground water in Wisconsin. Induced recharge of water-bearing formations results when the withdrawal works are so located and designed as to increase the natural rate of recharge from the surface. Installations using induced recharge are in use at Manitowoc, Wisconsin. These are located and constructed so as to induce recharge from Lake Michigan. Others are located at Superior, South Milwaukee and Nekoosa. Applied artificial recharge of aquifers is being practiced in a number of states for the purpose of developing barriers against salt-water encroachment and to augment natural and induced recharge. A number of examples are cited where various methods of combating salt water encroachment have been used, including Camp Cooke, California; Long Island and Brooklyn, N. Y.; El Paso, Texas; and Camp Peary, Va. A research project has been inaugurated to study the problems and effectiveness of recharge of the sandstone formations in the Milwaukee area. The purpose of the study is to de-

Courtesy Barber-Greene Co.

● **MONTGOMERY Dam is an earth fill structure. A 12-inch asphaltic concrete face is being applied here, using a Barber-Greene finisher, to insure watertightness.**

OVER A HUNDRED YEARS OLD...

"...in good working order"

CITY OF ALBANY, N. Y.

DEPARTMENT OF WATER AND WATER SUPPLY

WILLIAM F. DEVANE
COMMISSIONER

JOSEPH M. LAPENIS
DEPUTY COMMISSIONER

THOMAS F. FITZSIMMONS
SUPERINTENDENT
METERS AND ASSESSMENTS

JOHN C. McDONALD
CASHIER

October 25, 1957

Eddy Valve Company
Waterford, New York

Gentlemen:

We are enclosing a picture of a 6" Eddy Valve placed in service some time previous to the year 1851, this being the year the City acquired the Water Supply from a private company.

How many years prior to 1851 this valve was installed is problematical as Cast Iron water mains have been used in this city since the year 1613.

This valve is in the distribution system and is in good working order. In checking over a report of George W. Carpenter, Superintendent of the City Water Works, dated January 16, 1854, we find that valves at that time were called stop cocks.

We thought perhaps you would be interested in knowing about your product.

Very truly yours,

William F. Devane
Commissioner

WFD:k

EDDY valves and hydrants not only give the kind of service that Albany's Water Commissioner William F. Devane tells us about—but Eddy can supply repair parts for any and every valve they ever built.

It is important that future long-time service is a part of what you buy. When your municipality embarks on a waterworks modernization program make sure that the capacity and resources of your equipment supplier are such as to assure its maintenance—even for a hundred years.

That's why Eddy is a good company to do business with. Let us give you the facts and figures.

EDDY AWWA fire hydrants offer these advantages

They open smoothly with the pressure, close without water hammer. Entire operating mechanism is easily removed for inspection and repair *by one man.* Standpipe drains by automatic drip action.

EDDY has everything you need for underground water systems

Quickly available are AWWA gate valves, cutting-in valves and sleeves, tapping valves and sleeves. Call your EDDY man for complete details.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD NEW YORK

Here's HYDRO-MAGIC*

HYDROHOE Moves Dirt While Traffic Moves

Here's a hoe that trenches for water lines, sewer mains or house connections, uncovers leaks, digs valve pits and handles many other dirtmoving and lifting chores on busy city streets — *without* blocking traffic.

The all-hydraulic Hydrohoe supplies more digging and lifting capacity with less weight and in less space than ordinary machines. Extremely short tail swing and standard commercial truck mounting lets it work along curbs and gutters in little more space than a parked car.

The Hydrohoe's light truck mounting lets you travel through traffic at regular truck speeds . . . up to 50 mph on the open highway. Hydraulic outriggers that extend and set in seconds provide solid stability . . . take all working stresses off the truck.

A choice of dipper sizes and types gives you unsurpassed versatility. The 20-in. utilities dipper rotates from 45 degrees behind the handle to 50 degrees ahead . . . lets you dig short, deep holes with a minimum of waste time and effort. These HYDRO-MAGIC advantages make magicians of Hydrocrane-Hydrohoe operators in situations that stump operators of ordinary machines.

Put this fast, compact, all-hydraulic Hydrohoe on your jobs soon. Your nearby Bucyrus-Erie distributor will supply details.

204H57

A Familiar Sign BUCYRUS ERIE *at the Scene of Progress*

BUCYRUS-ERIE COMPANY • South Milwaukee, Wisconsin

* Ask your Bucyrus-Erie distributor to show you HYDRO-MAGIC — a new movie which dramatically shows the outstanding Hydrocrane advantages. Your Bucyrus-Erie distributor will be happy to arrange a showing for you.

termine: 1) The rate of discharge in terms of well production per foot of head; 2) the head recovery; 3) the recharged water recovery; 4) the method by which diffusion can best be determined; 5) the effect of injection water temperature; 6) the cost of recharge; and 7) the physical factors affecting recharge operations.

"Artificial Recharging of Water-Bearing Formations." By O. J. Muegge. *Jour. AWWA*, February, 1958.

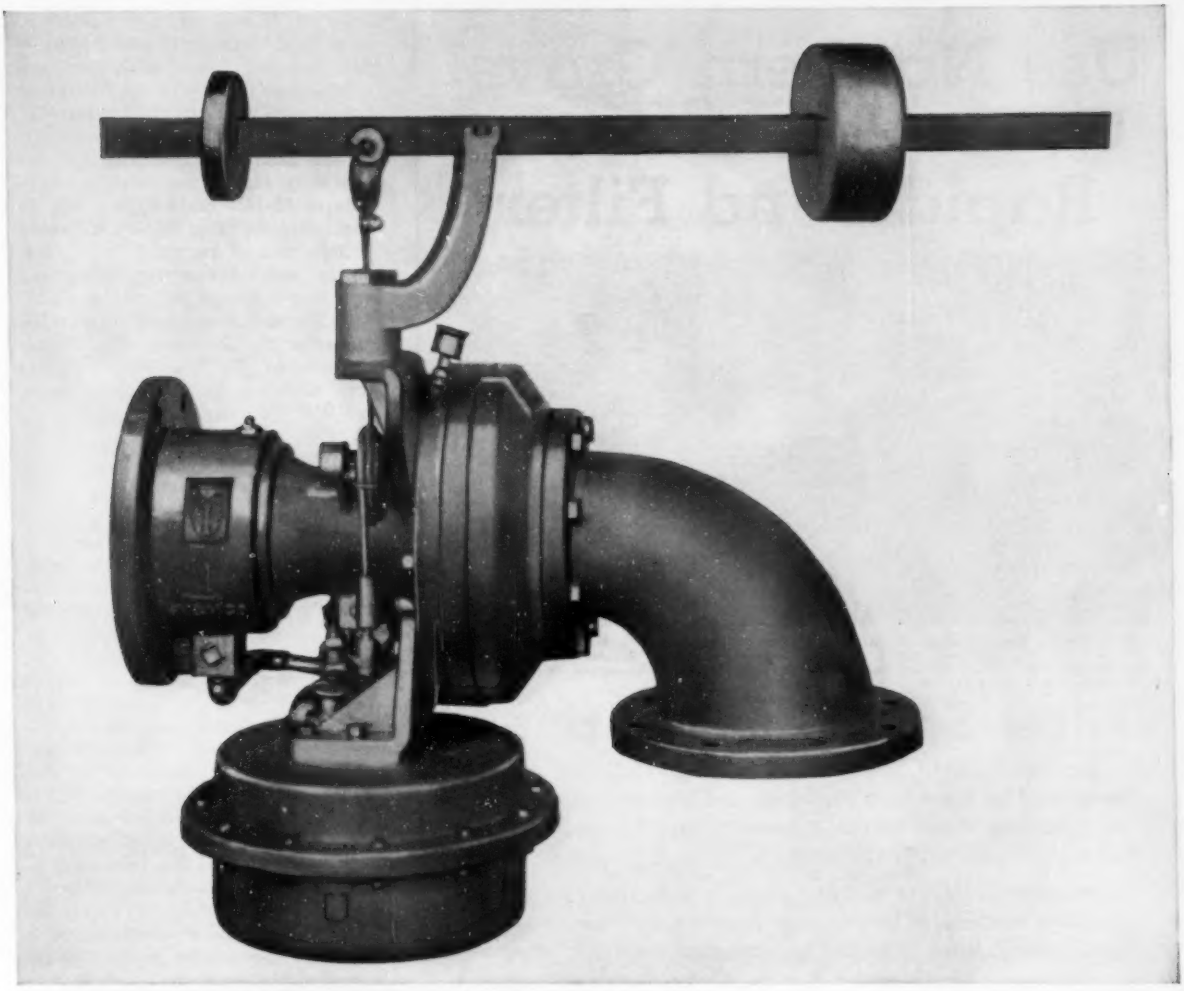
Filtration Rates

The author has reviewed the various factors affecting filtration rates. These factors are: 1) The quality of the raw water; 2) the quality of the pretreatment facilities and their management; 3) sand size; 4) bed depth; 5) head conditions; and 6) hydraulic conditions in the filter piping. The relations between these factors are relatively simple, however, and it is possible to determine just what filtration rates are safe to use at any given location, provided water quality measurements are accurate and filtered water clarity records are complete and cover a period long enough to assure that the critical limiting conditions have been included.

"Factors Affecting Filtration Rates." By Herbert E. Hudson, Jr., *Jour. AWWA*, February, 1958.

Improved MF Medium

An outstanding advance in methods applied in the field of water bacteriology has been the recent development of the membrane filter technique. Of its many advantages, perhaps the most significant is the ability to concentrate bacterial organisms from very much larger and, therefore, more representative samples. Recently, an improved medium, MF-Endo, was placed on the market to be used with the MF technique. Preliminary tests showed the medium to be superior in several respects. This article reports on the results of an investigation to determine the recovery and selectivity of this new medium for members of the coliform group. Confirmatory tests, carried out on the sheen and nonsheen colonies produced, involved the inoculation of lactose broth and nutrient agar slants for microscopic observation. It was concluded that 1) the medium produces colonies with excellent, clear-cut sheen characteristics; 2) that 92.3 per cent of 1,231 sheen



Direct-acting!

SIMPLEX "S" CONTROLLERS

keep filter rate uniform without outside power sources

Important? Yes! Because it eliminates the danger of run-away filters when power sources fail. In addition, you get continuing accurate control to the wide-open position . . . for longer runs. You save on pumping with full-area opening . . . and no flow obstructions at the wide-open position.

Compact Type "S" Controller is only three pipe diameters long. Fits anywhere—horizontally or vertically. Eliminates expense of straight-pipe approaches. Proven by twenty-five years' trouble-free service. And with virtually no maintenance—saves you money in the long run.

MAIL THIS COUPON TODAY! ▶

SIMPLEX®
VALVE AND METER COMPANY
A subsidiary of PFAUDLER PERMUTIT INC.
Venturi Tubes • Flumes • Meters • Gauges
Transmitters • Controllers • Tables • Air Valves

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DEPT. PW-4, 7 East Orange St.
Lancaster, Pa.

Send me new technical bulletin 900 that gives valuable design and performance data on Filter Controllers and Master Control Systems.

NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

Use Northern Gravel for Rapid Sand Filter

Philip Kobie, Superintendent of this Water Plant in Berea, Ohio writes: "Prices quoted to us were very good and orders were shipped without delay. This was appreciated because we only had a limited time to do this job. We will recommend this company anytime to any and every one."

Filter Sand Specifications

are carefully laid out. The Effective Sizes and Uniformity Coefficients used by Consulting Engineers and also recommended by the American Water Works Association are the result of long years of research and experience.

The Northern Gravel Company is equipped to give you prompt shipment whether it be one bag or many carloads, exact to specifications. Filter sand can be furnished with any effective size between 0.35 MM and 1.20 MM.

Chemical Quality

of the filter sand is also important. It must be hard, not smooth, and free of soluble particles. This requires perfect washing and grading facilities. We have every modern device for washing, drying, screening and testing.

Filter Gravel

supporting the Filter Sand Bed must be, in turn, properly graded to sizes calculated to support the Filter Sand, and be relatively hard, round and resistant to solution.

Northern Gravel has no equal in facilities and our reserves of both sand and gravel are inexhaustible. Northern Gravel Company has been in business over 40 years. We guarantee uniformity of products and our records enable us to duplicate your requirements on short notice. Our location is central and we have commodity rates in every direction.

Northern Gravel Company
Muscatine, Iowa

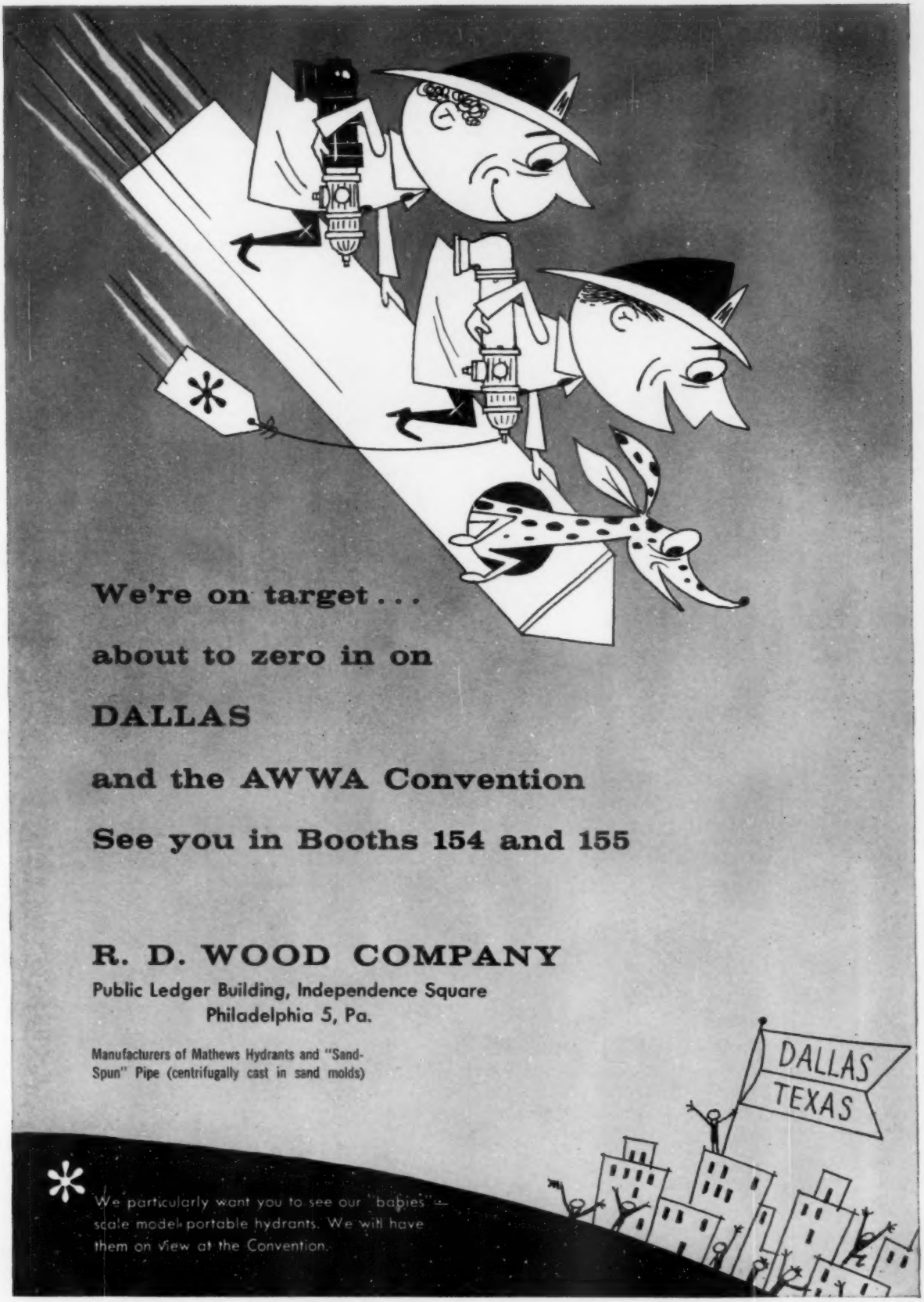
Box 307 Ph.: Amherst 3-2711

colonies picked were confirmed as belonging to the coliform group; 3) that 93.6 per cent of 1,222 nonsheen colonies picked were confirmed as not belonging to the coliform group; 4) that the coliform recovery rate of MF-Endo was found to be significantly higher than the recovery rate of M-HD Endo broth; and 5) that pure culture studies indicated a high rate of recovery for *Escherichia coli*, *Aerobacter aerogenes*, and five coliform intermediates.

"Improved Membrane Filter Medium for the Detection of Coliform Organisms." By Charles W. Fifield and Charles P. Schaufus, *Jour. AWWA*, February, 1958.

How Much Water is "Enough"?

In this age of increased growth of population in our major urban and suburban complexes, an increasing demand for water is being made upon the water works industry. Almost every municipal or private water facility must supply water to golf clubs, swimming pools, air conditioning units and industries that consume abnormal quantities of water during certain seasons of the year. In order to supply all the water needed upon demand, the facilities must be provided 365 days per year. These users are not paying a fair percentage of the total cost of providing these large quantities of water at a time when the water facilities are already operating at a peak. Larger mains, more storage tanks and increased pumping capacity are required and these "extreme demand" users should pay for the service they expect. The Philadelphia Suburban Water Co. has been studying this problem using experimental demand meter equipment to register these peak demands with the idea that a rate schedule should be established on a demand charge throughout the water works industry. Another interesting development by this private water facility is the establishment of a program of using ground water supplies in those suburban residential areas where it would be prohibitive to extend the present surface water supply. At the present time, there are three well supplies being used in the utility's territory. One of these supplies is located in an area some five or six miles remote from the nearest transportation main and consists of a well yielding 500,000 gpd, with a potential capacity of 3 mgd, and a standpipe. The plan is to use these well supplies as a nuclei of developments with a network of mains connecting to the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transportation mains that may be extended into these areas if and when the need arises.

"When Consumer Demands Mount, How Much Water is Enough?" By George H. Donn. *Water Works Engineering,* February, 1958.

No More Leakage and Tuberculation

The community of Massapequa, Long Island, N. Y., has had tremendous growth during the past 15 or more years, increasing from a population of 4,000 in the late 1930's to about 45,000 at the present time. Along with its growth the Massapequa Water District has had numerous problems that arose during this phenomenal expansion. The initial water main installations were begun in 1930. The water supply which is drawn from wells is acidic in character, having a pH of 4.9 to 5.2, and formerly caused considerable tuberculation and red water problems. One of the most difficult areas to supply water is along the shoreline where pipes are laid below the water table. New lines and tight couplings have served effectively to eliminate water losses in this area of Massapequa.

"Leakage and Tuberculation Troubles Overcome in New Main Extensions." By Robert Montgomery. *Water Works Engineering,* February, 1958.

Largest Pressure Filter Plant

Anacortes, Washington, soon starts operation of its 24-mgd pressure filter plant which will remove 3 to 4 mgL iron from the raw water obtained from two wells located on the banks of the Skagit River. This plant will serve the large naval base on Whidby Island, the Town of La Conner and three major industries, as well as Anacortes, a city with a population of 10,000. In fact this treatment replaces several filter plants now in operation and others that were contemplated. The filtered water flows into the header of the 12 pressure filters where a total of 300 cfm of air is injected for the oxidation of the iron. The aerated water flows through the pressure filters, each 45 ft. long and 10 ft. in diameter, and after filtration passes through four 13-foot square x 14 ft. high, forced draft aerators for pH correction and the removal of carbon dioxide. Chlorine will also be added to aid in oxidation and to satisfy State Health Department requirements.

"One Water Filter Plant Instead of Five." By H. W. Kramer. *The American City,* February, 1958.

Other Articles

"Effects of **Seeding Cumulus Clouds.**" By Roscoe R. Braham, Jr. and Louis J. Battan Jour. AWWA., February, 1958.

"Improvements in **Lime Slaking,** Feeding, and Slaking at Lansing, Mich." By John F. Dye. Jour. AWWA., February, 1958.

"Relationships of Temperature and **Air Conditioning Water Use.**" By Harris F. Seidel and John M. Carpenter. Jour. AWWA., February, 1958.

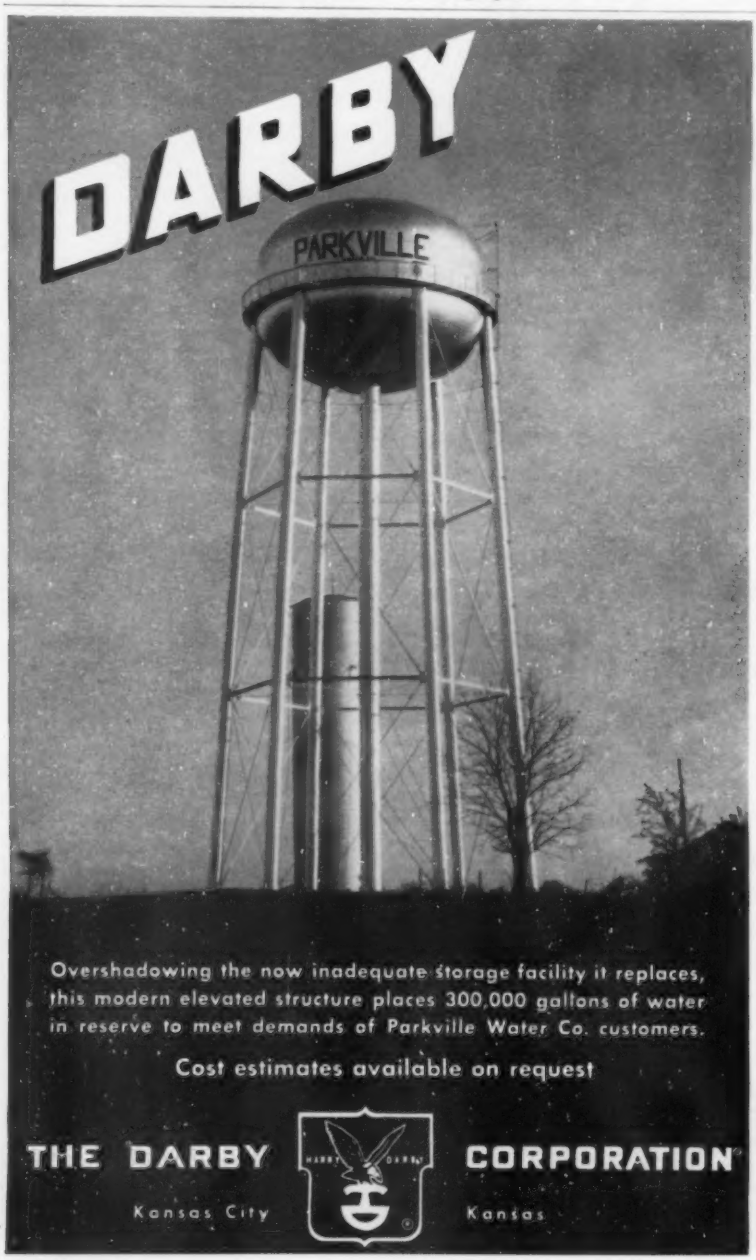
"Torque Characteristics of **Butterfly Valves.**" By A. E. Hatch and W. H. Chamberlain. Water and Sewage Works, February, 1958.

"Designing a **Water System for the Future.**" By Guy Browning Arthur. Public Works, March, 1958.

"Responsibility of the **Consulting Engineer** in Water Plant Construction." By Murray A. Wilson, JAWWA, February, 1958.

"Development of **Master Plans** to Meet Future Water Needs." A joint discussion presented on February 7, 1957 at the Indiana Section Meeting, Indianapolis, Ind. JAWWA, February, 1958.

"**Financing Small Water Utilities** in California." By Allen D. Harper. JAWWA, February, 1958.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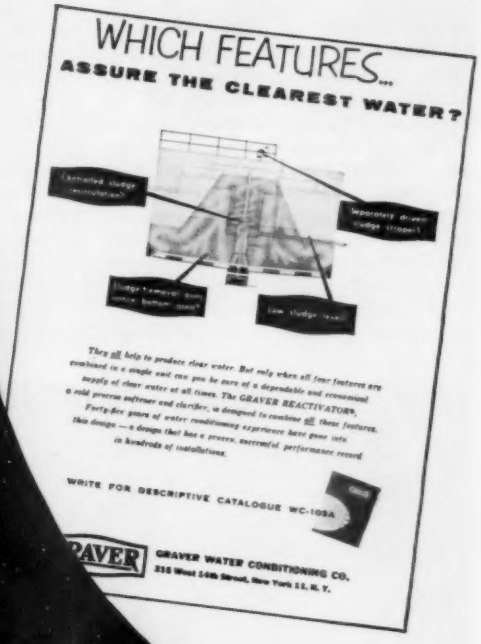

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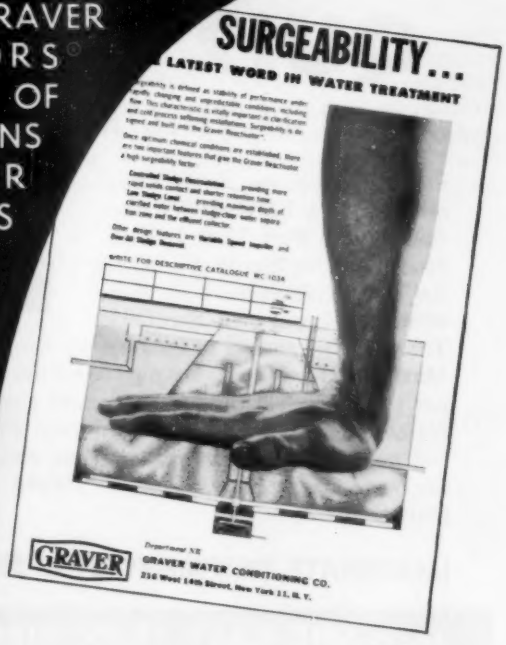

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TOWN SITE AT GLEN CANYON DAM

THE TOWN of Page is being established as an essential adjunct to the construction of Glen Canyon dam and power plant. The community is named after the late John C. Page, Commissioner of Reclamation from 1937 to 1943. It will make available housing and community facilities and services for both the contractors' forces and the Bureau's engineering employees during construction, as well as personnel who will operate the dam and power plant after they are completed. The town site is located in an isolated area 2 miles southeast of the dam site in Coconino County, Arizona. It is 135 miles north of Flagstaff, the county seat, and 72 miles east of Kanab, Utah.

Maximum population of the town during construction of the dam and power plant may reach about 8,000. After completion of major construction, which will be in about 8 years, the population may be stabilized at about 4,000. Page will be a permanent community and residents will be engaged in Federal, state, and municipal activities and services; recreation and tourist services; personal services; general business enterprises, and industries that may be attracted to the area.

The town, which will occupy about 550 acres, is to be built on Manson Mesa which is at an elevation of 4200 feet, or about 1,000 feet above the normal river elevation. Streets for the town are to be laid out in a curving pattern to comform to the topography of the mesa. The master plan for the town provides areas for Government residences, services and businesses, schools, motels and an administration and hospital area. A 13-acre park is to be developed, and a series of play areas are to be set aside in each of the residential areas. Space is also provided for future additions to the town. The contractors' community area is to be built to the east of the business area. An airstrip, approximately 6,000 feet in length, will be built near the contractors' residential area.

Specifications for the construction of the dam and power plant require the contractor to construct a 25-bed hospital. An elementary and a junior-senior high school are to be built by local and state educational agencies. Shopping, service and other business facilities to be constructed in the business area will be operated by private interests on a lease, concession or franchise basis.

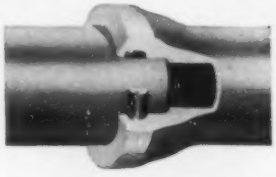
The architectural design of all buildings is to be of contemporary style. All permanent residences and buildings are to have electrical, water, gas and sewerage facilities.

Construction of the domestic water supply system has begun. A 3 mg. steel storage reservoir and a 150,000-gallon steel elevated water tank are to be erected adjacent to the town.

Until facilities are available in Page, Government forces and each contractor engaged in early phases of the work have chosen or have been assigned sites for their temporary camps, offices or construction facilities, depending on their individual requirements. Most employees are living in trailers. Other trailers and demountable or temporary buildings are serving for offices and shops. Engine-generator sets are providing power, and communication depends on mobile radio, field telephone or messenger. Water is hauled, pumped from deep wells, or pumped from the river.

QUIZ SHOW

WHAT IS THIS MAN DOING?



Photograph shows a workman assembling a McWane *Tyton Joint with a Fork Tool. It is all done in a couple minutes, after the Tyton Gasket has been placed in the Tyton bell. The Fork Tool is either rented or sold by McWane. However, many pipe crews use an ordinary crowbar to accomplish the same thing on pipe 2-inch to 8-inch diameter. McWane Tyton Joint pipe eliminates need of bell holes, reduces construction time and costs. Write for McWane Tyton Joint Folder. *Patent Pending, Trademark ®

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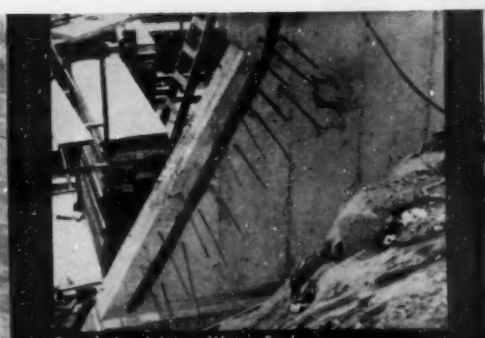

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Splicing into "L" and "T" joints. All it takes is a hot knife.

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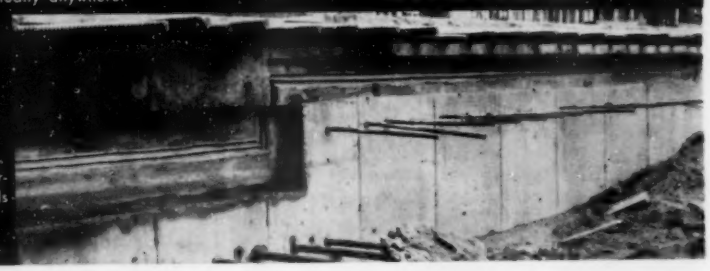
Indented pour. Normal agitation fills corrugated ribs.



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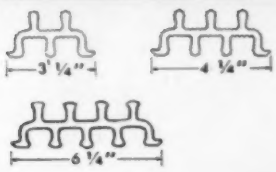
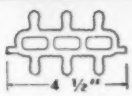
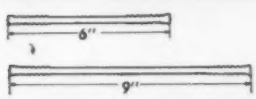


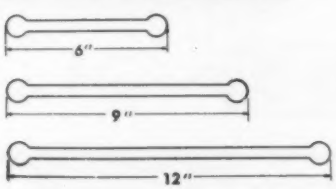
CELLULAR



FLEXTRIP



DUMBBELL



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PUBLIC WORKS DIGESTS

Prepared by
CLAYTON H. BILLINGS
Associate Editor

THE INDUSTRIAL WASTE DIGEST

Phenol Waste Recovery

The original phenol recovery plant for the Durez Plastics Div., Hooker Electrochemical Co., at North Tonawanda, N. Y., was designed before legal restriction were imposed on the disposal of effluent. Consequently economics governed the design and operation. While an effluent standard of 500 ppm phenol was the goal, this was seldom obtained because the equipment was easily fouled with resin. It was decided to try isopropyl ether as a solvent instead of benzene. Among the considerations was safety, in view of the reported possibility of formation of explosive compounds from decomposition of the ether. This proved to be of psychological advantage in alerting plant personnel; it contributed to their safety consciousness. During a full year of operation, however, no trace of the peroxide was detected. The phenol recovery process is countercurrent extraction, with two extraction stages, and with recycling the ether. The first extraction column is 3 ft. in diameter and 30 ft. high and is packed with 2-in. Raschig rings; the second, the same height but 3.5 ft. in diameter is packed with smaller rings. Waste flash steam from a nearby process provides the necessary steam for stripping the water raffinate of ether and phenol. The phenol remaining in the effluent was found to decrease with an increase in the ratio of ether to water in the extraction system. Normal operation has been at a ratio of 0.5 with a combined flow of 15 gpm, which resulted in a phenol concentration of 500 ppm in the effluent discharged. The requirements for steam and ether, respectively, are 4 lb. and 0.03 lb. per lb. of phenol recovered. It is apparent that as stages of extraction are added, recovery is enhanced, but the capital investment required is greatly increased, so that the cost of achieving zero phenol concentration in the effluent is prohibitive. The process is, however, capable of producing an effluent containing less than 100 ppm phenol, which is within the range of treatability, after dilution, by conventional sewage treatment plants.

"Phenol Recovery by the Use of Isopropyl Ether." By N. B. Kirchgessner, Durez Plastics Div., Hooker Electrochemical Co. *Sewage and Industrial Wastes*, February, 1958.

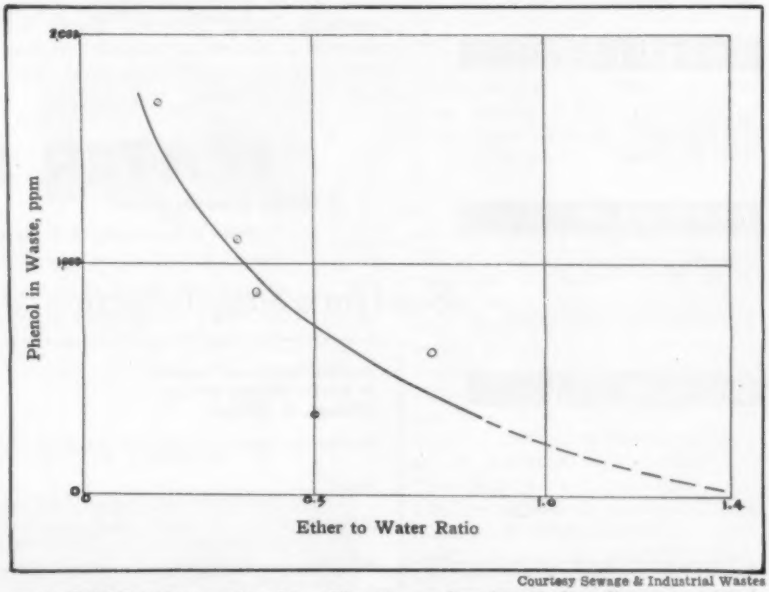
Designing for Waste Treatment

The consulting engineer must have dependable information on the constituents of a municipal sewage before he can design a plant to treat it efficiently. The location of discharge of interfering industrial waste and the amount and characteristics of such effluents must be known. Agreements with industries should be sought, limiting wastes discharged to those subject to treatment with sewage, bolstered by city ordinances in large cities. The consulting engineer must then design a plant for the anticipated loading including BOD, suspended solids, ether-soluble matter and pH. The treatment plant superintendent, if one exists, is likely to have a wealth of experience which should be consulted in arriving at the ultimate design. Choosing equipment must be done carefully, for effectiveness and for providing the necessary years of service. Substitutions proposed by the contractor should be evaluated by the engineer, and the municipality should back up the engineer's judgment. After the plant is completed, the contractor should prove to the consultant and the city that all equipment will operate as specified and the trial period should be adequate to avoid unfair condemnation.

"Who Is Responsible for Plants Which Treat Process Wastes with Sewage?" By Arthur B. Caster, City of Cincinnati. *Wastes Engineering*, February, 1958.

Inoculating Sewages With Radioactivity

To obtain advance information on the possible pollution from placing the expanded Los Angeles sewage treatment plant into operation, scandium-46 was introduced into sewage being discharged to Santa Monica Bay. Selection of the iso-



Courtesy Sewage & Industrial Wastes

● CURVE indicates phenol in effluent as a function of the ether-water ratio.

Clay Pipe for Long-Range Economy

MADISONVILLE, KENTUCKY, is so efficiently managed that for the third successive year no property taxes were levied. With this record for efficiency, it is only natural that corrosion-proof Clay Pipe was chosen for the city's new sewerage expansion program. More than twenty-two and a half miles of Vitrified Clay Pipe are going into the project.

In the opinion of J. Sanders Parker, Consulting Engineer, Clay Pipe is "the best that could be obtained for this service." Clay Pipe never wears out . . . does not rust, rot, or disintegrate . . . is the only pipe backed by a long-term written guarantee. And the new stronger, longer lengths speed installation . . . cut labor costs.

When investigating materials for sewer expansion, remember . . . substitute pipe may have *some* of the features of Clay Pipe, but only Clay Pipe has *all* the features you can trust.

Public Officials: David Parish, *Mayor;* A. O. Johnston, *Councilman, Chairman of Water and Sewers.*

Consulting Engineers: J. Sanders Parker; F. E. Stepp, *Resident Engineer.*

Contractors: C. F. W. Construction Co., Inc.; Sterrett Construction Co.

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tope was based on the possibility of adhering to radiological health standards, its short half-life, the cost, chemical compatability with the effluent and with sea water, and suitability for measurement in dilutions of 1 to 10,000. Twenty curies of scandium-46 were introduced during a one-hour period using apparatus consisting of a 50-gallon tank equipped with a stirrer, a needle valve, and a rotameter. The tank and the needle valve were shielded with 30 inches of packed sand for protection of the operator. To minimize adsorption of scandium chloride, a sodium Versene complexing agent was used. All personnel were equipped with film badges and self-reading dosimeters. Also, an ionization chamber-type survey meter was used to monitor all operations. After the conclusion of the operation, all equipment and surfaces were repeatedly flushed with cold water, cold water and sodium Versene and boiling water containing EDTA and Versene until the radiation level was reduced to a factor of 3. The equipment was then dismantled and was further decontaminated with live steam and boiling EDTA. Contaminated wash solutions were poured into the plant sewage stream and diluted until the scandium-46 concentration was about 10,000 times below drinking water tolerance.

"Selection and Handling of a Radio Tracer for Studying Sewage Distribution." By Eli I. Goodman, Nuclear Science and Engineering Corp. *Industrial and Engineering Chemistry*, February, 1958.

Tracer Method Detects Air Pollution

In searching for a method of studying distribution of stack gas emissions, a plan was devised which would have the advantages of tracer technique without the disadvantage of excessive manpower requirements. With the method developed, it is possible for 2 men to handle all the details in a survey of considerable magnitude, at correspondingly low cost. Antimony oxide was selected as the tracer substance because it is not normally present in the atmosphere in significant concentrations and because it is susceptible to easy detection by the neutron activation technique employed. AISI automatic smoke samplers were used, in which samples are continuously passed through filter paper. In application of the method, the antimony oxide was discharged into a selected gas stream. Samplers were located at strategic points. Spots on the filter paper tapes were irradiated in an atomic pile, and the quantity of tracer substance present was determined by measurements of induced radioactivity. It was found that quantities of the tracer powder as small as 0.01 micrograms could be recognized.

"Method for Tracing the Ground-Level Distribution of Stack Gas Emissions." By G. F. Haines, Jr. and W. C. L. Hemeson. *Journal of the Air Pollution Control Association*, February, 1958.

Waste Disposal By Incineration

Most oily wastes from paint factories, printing ink works, and chemical industries (liquids, oil-soaked solids, sludges) can be incinerated without difficulty and without nuisance. Methods available for getting the wastes into the furnace are: (1) introducing them through a water seal, (2) using standard burner equipment for free-flowing solid-free waste, (3) using a tray type burner for free-flowing high solids wastes, (4) using batch charging or solids conveyors for non flowing wastes. The calorific value, density, and quantity deter-

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Today the progressive Dallas Water Department under the direction of its able superintendent, Mr. Henry J. Graeser, is taking a real long look into the future. It is making feasibility studies of new water sources that will continue to support the water needs of Dallas in the year 2000!

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mine the size of the furnace. The flash point determines the best means of ignition, and the type of refractory depends on the chemical characteristics. Since hydrocarbons are present, it is necessary to provide a controlled rate of burning, ample supplies of secondary combustion air, and sufficient space and time for the mixing of waste gases and secondary air. Incombustible solids are likely to be present, and to minimize fly ash emission, the gases should be swirled centrifugally and expanded. Sometimes it is necessary to wash the flue gases. The centrifugal fly ash catcher can be fitted with a recirculating water-operated gas washer. Yields of 3 to 4 lbs. of steam per lb. of refuse at pressures up to 150 lb. per sq. in. are usual when the heat released is used for the production of steam.

"Smoke-free Incineration of Liquid Wastes and Sludges." By R. F. West, Incinerator Co., Ltd. *The Surveyor*, January 18, 1958.

Treatment of Wastes with Sewage

Since there is no longer any question regarding the feasibility of treating most wastes with domestic sewage, the problem is primarily of coordinating the efforts of industries and municipalities so that waste disposal is a joint, cooperative effort. Industry should include waste treatment costs in each process balance sheet, including the net cost of recovery versus treatment, should evaluate the waste treatment phase of each new process before it is placed into operation, and should keep municipalities and regulatory agencies having jurisdiction fully advised. Municipalities also have responsibilities, not the least of which is the economic place industry has in community prosperity. Both industries and cities are desirous, at management levels, of achieving the same net result, a cooperative solution to the problem. The operation staffs of each, however, are likely to develop antagonistic attitudes; the sewage treatment plant superintendent because his life becomes more complicated, and the production manager of industry, because restrictions are placed on production ability. Only close liaison and cooperation can effect a happy solution. At Peoria, Ill., variable loadings on the municipal plant are experienced from wastes from paper mills, breweries, and packing houses. In spite of this, it has been found that process adjustment is possible with the Peoria Sanitary District's activated sludge plant, in order to produce a continuously satisfactory effluent.

"Combined Treatment of Industrial and Domestic Wastes." By L. S. Kraus, Greater Peoria Sanitary District. *Sewage and Industrial Wastes*, February, 1958.

Other Articles

"Foul Condensate Treatment and Disposal." A report of the Oil Refining Industry Action Committee of the Ohio River Valley Water Sanitation Commission. Sewage and Industrial Wastes, February, 1958.

"Recovering **Fission Products."** A process is described for recovering long-lived fission materials from waste solutions from solvent extraction of nuclear reactor fuel elements. By G. B. Barton, J. L. Hepworth, E. D. McClanahan, Jr., R. L. Moore, and H. H. Van Tuyl. Industrial and Engineering Chemistry, February, 1958.

"Emissions from Organic Solvent Usage in Los Angeles County." The problem was surveyed and control means were explored. By R. G. Lunche, A. Stein, C. J. Seymour, and R. L. Weimer, Journal of the Air Pollution Control Association, February, 1958.

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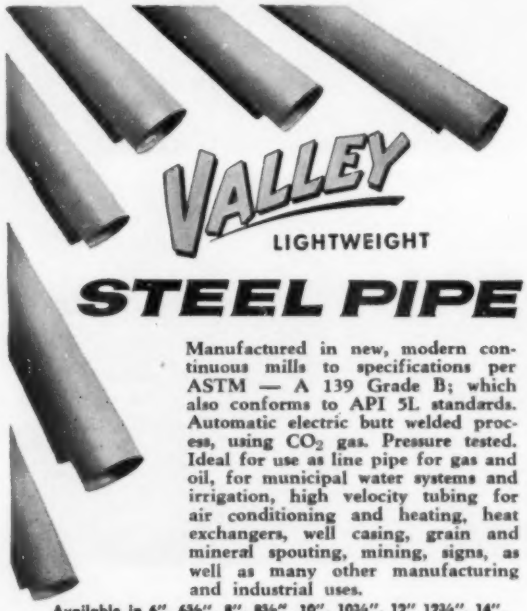

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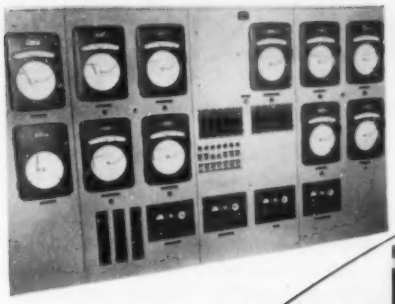

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INSECTICIDE RESISTANCE

From a paper by A. W. A. Brown in "World Health"

THE WONDERS of DDT in reducing the great insect-borne pestilences, such as malaria, yellow fever, typhus, plague and many types of dysentery, are well known. Recent findings show that in some parts of the world DDT is no longer controlling the mosquitoes, lice, fleas, and houseflies that transmit these diseases, and—although difficult to realize—it is the insects which have changed to become resistant to DDT.

The phenomenon of insecticide resistance was first observed in agriculture. In 1913, it was proved that the San Jose scale—an insect pest of apple orchards—was no longer controlled by lime-sulfur in the State of Washington because the insect had lost its former susceptibility. Following that, several instances of poisons no longer affecting various insects were reported.

DDT Experiences

This was the picture when, towards the end of World War II, DDT was introduced for malaria mosquito control. In the spring of 1947, in the coastal plain of the Tiber, it was found that houseflies were no longer killed through contact with sprayed walls of houses and that respraying with DDT of certified quality would no longer control them. On being taken into the laboratory and bred for generations free of DDT, these flies maintained this DDT resistance. At first, public health scientists thought they had discovered a new variety of housefly which they named *Musca domestica*, var. *tiberine*, even though no visible differences from the normal species could be found, but laboratory experiments started two years previously in Orlando, Fla., had shown that if susceptible houseflies are exposed to DDT in each generation and bred from the survivors, the susceptibility steadily decreases until the flies become practically resistant.

In the same year, DDT-resistant houseflies appeared in Greece and Denmark; and, in 1948, in New York, New Jersey, Illinois, Florida, and California. Subsequently, it was found that wherever DDT was brought into systematic use, the flies became DDT-resistant in about two years. Laboratory experiments confirmed that selection pressure with DDT made a DDT-resistant strain out of a normally susceptible one and that no visible anatomical differences characterized the resistant strain.

One exception should be mentioned, namely, the DDT-resistant flies discovered at Arnas in Northern Sweden in 1946 which were darker and thicker-skinned in the feet and tarsal pads; but this is probably a normal characteristic of the houseflies in that cold country.

Other Insecticides

New insecticides such as benzene hexachloride (BHC), chlordane and dieldrin produced encouraging results at first, but generally within a single year the houseflies again showed resistance. Compounds were discovered which, added to DDT, made it insecticidal to resistant flies; however, in a few generations of exposure the flies became resistant to the mixtures.

At present, a class of compounds known as the organophosphorus insecticides (e.g., parathion, malathion, and diazinon) has been introduced for fly control. Although these are not so effective as DDT and the other chlorinated hydrocarbons were, the housefly does not become resistant to them very quickly. However, control failures with organophosphorus compounds have recently developed in Denmark.

Mosquito Resistance

Not until about 1951, did any doubt appear to disturb malaria control by DDT house spraying. Anti-malaria workers in Greece found in the fifth year of their countrywide program that the mosquito vectors, *Anopheles sacharovi*, were resting on sprayed walls. As the years went on, the situation became worse and more widespread; the resistance extended to BHC, chlordane and dieldrin and involved the two other local species of *Anopheles*.

Also in 1951, when DDT powder was used for delousing, the first problem arose in typhus control. Soldiers of both armies in Korea were found to harbor body lice that were resistant to DDT. A similar resistance was found in the lice infesting vagrants in Japan. In succeeding years, DDT resistance has developed in Egypt, Iran, Turkey, Ethiopia, South Africa, Chile, Peru, and other countries. BHC resistance is now general in Japan. By 1951,

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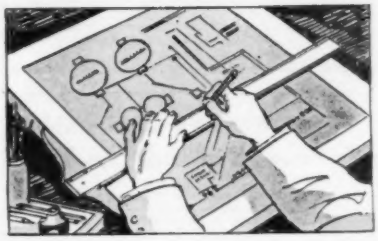

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DDT resistance of the flea, *Pulex irritans*, vector of plague, had developed in Peru, Ecuador, Greece, and Palestine. In 1955, DDT resistance was reported in the yellow fever mosquito, *Aedes aegypti*, in Trinidad.

At present, resistance to DDT is shown by the bedbug in parts of the United States, India, Iran, Israel, and Taiwan. The German cockroach has developed resistance to chlordane and similar insecticides in most urban centers in the southern United States. The cattle tick in Australia and the blue tick in South Africa are resistant not only to BHC, but to chlorinated hydrocarbon insecticides in general.

Causes of Resistance

So the insects are fighting back in their own way as dictated by the laws of Nature. Through what qualities have they become resistant where they were susceptible before?

One possibility is that they are tougher and can better withstand inimical conditions, whether heat, cold, drying-out or an insecticide. Being tougher was probably a characteristic of the DDT-resistant houseflies in Northern Sweden. Instances where flies or mosquitoes gradually accumulate moderate resistance to insecticides in general—not just to the one being used—fall into the category to which American workers have given the name "vigor tolerance." Generally, resistance is much more specific than this and there are many examples of intense DDT resistance without any increase in general toughness or decreased susceptibility to other insecticides.

Biochemical research in the United States has shown that DDT-resistant houseflies contain an enzyme which normal susceptible strains do not (or if so, in traces only). This particular enzyme, DDT dehydrochlorinase, is present in all tissues of the fly and especially in its integument or body wall. As the DDT enters the body through the integument, this enzyme dehyrochlorinates it, leaving the harmless compound DDE. The same enzyme protects the internal tissues from any DDT that may get into the body cavity unchanged. A similar detoxification mechanism is found in the resistant *Aedes aegypti* mosquito from Trinidad.

Laboratory experiments over many months have shown how the application of DDT (or BHC, dieldrin, chlordane, etc) can build up resistance from generation to generation. If the flies are then re-

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moved from the insecticide, the resistance persists for several generations at least—it is present as a fixed characteristic.

Exposure of a fly or other insect to mild doses of DDT does not make it more tolerant of heavier doses given later. The resistance level of the next generation cannot be increased unless the DDT has been at such a level that it has killed off the more susceptible of the prospective parents. This is the Darwinian theory of evolutionary change by environmental selection in its pure and classical form and sets it against the Lamarckian fallacy that all changes are acquired from the environment and all so acquired are inherited.

Those flies that are constitutionally (i.e., genetically) less susceptible survive to produce the next generation. The genes they contain which make for less DDT susceptibility make the next generation more DDT resistant than the last. Successive elimination of individuals with genes for DDT susceptibility concentrates the DDT resistance genes more and more so that ultimately the population is entirely DDT resistant.

Theory of Gene Selection

Where do these DDT-resistant genes come from? Can they have been introduced through mutation from normal genes by the action of the DDT itself? A very few chemicals (i.e., colchicine, nitrogen mustard) are known to be mutagenic, but DDT has been proved by recent experiment not to induce mutations. Therefore, it is concluded that in the housefly the genes for resistance are present in normal populations in very low frequency only awaiting selection by the insecticide—DDT in this case—to increase that frequency in successive generations.

Supporting evidence for this view has recently come from northern Nigeria. Since June, 1954, the houses had been sprayed with dieldrin against *Anopheles gambiae*. After three cycles of spraying, some of these mosquitoes were submitted to test in November, 1955, and found to be (as a group) eight times as resistant to dieldrin as those in an unsprayed area. Eggs of *A. gambiae* were collected from Ambursa in the sprayed area and airmailed to the Ross Institute in London. Approximately 5 percent of them hatched—enough to found a laboratory colony which was surprisingly easy to breed. As soon as it had reached sufficient size, a group of this colony was submitted to test with dieldrin. As a group, it proved to be 800 times

as resistant as a normal *A. gambiae* colony from Lagos in coastal Nigeria. The dieldrin - resistant Ambursa mosquitoes were then mated with the susceptible Lagos mosquitoes. The results of the mating crosses through three generations showed that the hybrids were intermediate in resistance and carried one gene for dieldrin resistance while the Ambursa strain carried two.

A survey in Northern Nigeria showed that in sprayed areas 90 percent of the mosquitoes found in the houses carried two of the resistant genes while in an unsprayed area 0.04 percent carried one of the resistant genes (the other individuals carrying the normal susceptible genes). These results show that a gene giving dieldrin resistance existed in this species of mosquito *before* the species ever came in contact with this insecticide.

The future course is now clear; research must go on. Regions of Africa in which dieldrin might be used in malaria control must first be surveyed to see if this particular gene exists in the indigenous *A. gambiae*. Where it does, the use of dieldrin is doomed to eventual failure. However, the dieldrin-resistant *A. gambiae*, although resistant also to BHC, is quite susceptible to DDT. Therefore, DDT should be the insecticide of choice against such populations and indeed the Nigerian operations in 1956 showed it.

The dieldrin-resistant *A. quadrimaculatus* of the United States is still controlled by DDT. On the other hand, the DDT-resistant *A. sundaicus* in Java is still susceptible to dieldrin and so is *A. stephensi* in Arabia. The DDT-resistant *Aedes aegypti* is susceptible to BHC.

It has been the experience with the housefly, with *Culex fatigans*, and with *Anopheles sacharovi* in Greece that DDT-resistance may be quite quickly followed by resistance to the other chlorinated hydrocarbons, thus eliminating the only group of insecticides which have made nationwide disease eradication programs economically feasible. Insecticides of long residual effect against mosquitoes have not been found in any other group.

In the race between these eradication campaigns and the development of insecticide resistance, there is an urgent need for increased research on many fronts—for only research provides the knowledge and understanding which may produce countermeasures against the onset of resistance.

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EQUIPMENT NEWS

10-Key Calculator

Calculator is used by survey parties and by highway construction engineers

A 10-key personal calculator that adds, subtracts, multiplies and divides, yet weighs only six pounds is available from the Bohn Duplicator Corp. The BDC Contex is manually operated, but has no "handle" in the ordinary sense. Its actuating bar is similar to the motor bar on electric machines. It is depressed with the palm of the hand, without removing the fingers from the keyboard. It has a capacity of ten digits entered, eleven total. Sub-totals are shown at every step, and subtraction is direct. For further information, write Bohn Duplicator Corp., 444 Fourth Ave., New York 16, N.Y., or circle **No. 4-1** on the reply card.

Submersible Pumps To 13,000 GPH

A new line of 6-in. diameter submersible pumps is announced by The F. E. Myers & Bro. Co. These are particularly suitable for deep well installations where moderate volumes of water are needed. The pump can be installed in wells as deep as 700 ft. The top capacity at a 50-ft. depth is over 13,000 gallons of water an hour. The Myers SC submersible operates completely under water and is a combined pump and motor unit. The 60-cycle motor is oil lubricated, sealed, and drives the pump through a rigid coupling. Power is supplied to the submerged motor by a waterproof cable that is attached to the riser column pipe. The pump is available in 5, 7½, 10 and 15-hp sizes. The pump unit is a multi-stage centrifugal turbine pump and is made in either flat pancake stages for lower capacities at high head, or a turbine bowl type construction for higher capacities at lower heads. For more data write The F. E. Myers & Bro. Co., 249 Orange St., Ashland, O., or circle **No. 4-2** on the reply card.

Chevrolet Pickup Trucks

Addition of three newly styled "smoothside" pickup truck models featuring full-width cargo boxes with 50 percent more cargo space is announced by Chevrolet. The new pickups, identified as Fleetsides, are offered with either 6½ or 8-ft. box lengths on two wheelbases in the ½-ton series and an 8-ft. box in the ¾-ton model. Both boxes have an inside width of 6 ft. 3 ins. and are 19 inches deep. Bolt-on heavy-gauge steel upper and lower side panels overlap, affording double wall protection to the lower half of the box to minimize deflection under load. Floors are of durable seasoned hardwood with flush type steel skid strips. They are not subject to corrosion, are quieter and provide safe footing wet or dry. Addition of the three new models brings the number of pickup trucks offered by Chevrolet to 10 and expands the 1958 truck line to 136 models. For more data write Chevrolet Motor Div., General Motors Corp., General Motors Bldg., Detroit 2, Mich., or circle **No. 4-3** on the reply card.

Load space for hauling bulky cargoes is provided by these new pickup trucks

Tractor has 4-wheel hydraulic brakes, mechanical PTO, short turning radius

Four-Wheel-Steer Tractor

A four-wheel-steer tractor called the Napco Crab has been announced by Napco Industries. A three-position selector allows the operator to choose front wheel steer, front and rear wheel steer or oblique steer. (Both front and rear wheels turn in the same direction.) The tractor is extremely versatile and will handle a variety of special attachments such as post hole diggers, backhoes, forklifts, loaders, plows, subsoilers and dozers. For more details write Napco Industries, Inc., Seventh St., North Lyndale, Minneapolis 11, Minn., or circle **No. 4-4** on the reply card.

Flexible Fin Traffic Control

Flexible fin lane dividers, from Riner Corp., insure positive yet flexible traffic control and are available in 2 models. The dividers are composed of individual cast iron units linked and locked together in any desired road length. Painted to your color specifications, they provide high visibility and immediate lane identification. Their raised grid design causes a rumbling warning when driven upon and discourages cross-over by traffic. Once in place, lane conversion is accomplished by using a jeep with a unique conveyor attachment that can be set-up for ½, 1 or 2 lane throw-over in a matter of minutes. For more information write Riner Corp., 8 South Michigan Ave., Chicago 3, Ill., or circle **No. 4-5** on the reply card.

Double-Acting Catch Basin Cleaner

This machine can work as a truck crane when not used as catch basin cleaner

The Stetco double-acting catch basin cleaning unit, made by Stedt Hydraulic Crane Co., is a multi-purpose machine. When not used for cleaning catch basins the buckets are dropped leaving the truck crane for general work. The crane has a capacity of 2200 lbs. One truck cleans the catch basins and loads into its own body. One-man operation is all that is required. More data from Stedt Hydraulic Crane Co., 93 Cordaville Road, Ashland, Mass., or circle **No. 4-6** on the reply card.

Marbelite Single-Dial Controller

A 5 to 15 percent increase in traffic flow, with fewer tie-ups and accidents, is reported by communities installing the new Marbelite M-20 single-dial controller. It not only covers current needs, but can be readily adapted to handle increased loads and changing patterns in the future, such as those caused by industrial and residential expansion and relocation. Remote control of flashing, emergency all-red, or signal shutdown is available, plus the choice of a synchronous motor-driven jack mounted flasher or an integral flasher in the dial unit. The dial unit is supplied with five cycle gears, each ranging from 30 to 120 seconds in 5-second steps. Signal switching is accomplished with the new motor-driven camshaft, which is shockless and vibration-free. For full information write Marbelite Co., 179 N. 10th St., Brooklyn 11, N.Y., or circle **No. 4-7** on the reply card.

Cedarapids Bituminous Paver

The Cedarapids bituminous paver built by Iowa, embodies a completely new concept in bituminous paving. The machine on tests has worked at speeds of 65, 84, and 102 feet per minute without tearing the bituminous mat and has produced uniform high densities at these speeds. An electrically-vibrated screed which "irons" the bituminous material into a smooth, uniform, high-density mat enables the paver to move at high speeds. The screed is of one-piece construction and is vibrated at 3600 impulses per minute by four electric vibrators, each of which is controlled by a rheostat to regulate the intensity of vibration. Paving width can be adjusted from 6 to 16 ft. in 1½-in. increments. Heat from a 150,000 BTU oil burning heater is evenly distributed to the screed by an enclosed flue. For more data write Iowa Mfg. Co., Cedar Rapids, Ia., or circle **No. 4-8** on the reply card.

Bituminous paver can lay asphaltic concrete at speeds up to 84 ft. per min.

Turbo-Supercharged Opposed-Piston Diesel

A turbo-supercharged opposed-piston engine has been announced by Fairbanks, Morse. Turbocharging is available in the 6-cylinder and 12-cylinder configurations of the 8⅛ x 10-in. opposed-piston engine. The weight of the 6-cylinder basic engine is approximately 24,900 pounds and the weight of the 12-cylinder unit is approximately 46,-200 pounds. At its top rating of 3600 hp, the 12-cylinder diesel weighs only 12.8 pounds per hp. Recommended speeds will vary, of course, with the application.. It is expected that most stationary power plant installations will operate at 720 or 750 rpm. Space required for installation of the supercharged engine is virtually the same as for the non-supercharged unit since the turbochargers are mounted on the end of the engine and extend little beyond normal piping connections below. For full details write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill., or circle **No. 4-9** on the reply card.

Shunk 'Gator Twistooth Blade

Production of a new cutting edge for earthmoving and road maintenance equipment has been announced by Shunk Mfg. Co. Called the Shunk 'Gator Twistooth blade, the new cutting edge features teeth on the cutting surface that vary from each other in the angle they enter the earth or road surface. In this way, and because of the chisel-shaped design of the teeth, only a minimum of blade area is required

for initial contact with unbroken surfaces. The new type blades are designed especially for heavy-duty service. Another important advantage of the blade is that it crumbles material to the point where it improves the spread pattern and permits faster and more even discharge. It has proved particularly useful for bulldozers, graders and front-end loaders — particularly where this type equipment is used in exceptionally hard earth or material that normally proves difficult and costly to handle. For further information write Shunk Mfg. Co., Bucyrus, Ohio, or circle **No. 4-10** on the reply card.

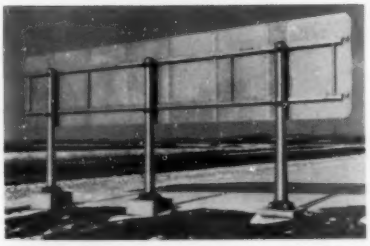
Tractor-Shovel

A new 2¼-cubic yard tractor-shovel, known as the Model 200, has been announced by N. P. Nelson Iron Works. This new tractor-shovel has been designed and built for heavy duty work. The underslung arms provide 100 percent operator visibility and safety. Bucket has 40° tip-back at ground level. Maximum dumping height is 9½ ft. with a forward reach of 5 ft. 7 ins. It has 4-wheel drive Timkin-Detroit planetary axles with torque proportioning differential to give maximum traction. The Model 200 is powered by a Continental 117-hp gas engine or GM 3-71 diesel. For further information write N. P. Nelson Iron Works, 850 Bloomfield Ave., Clifton, N. J., or circle **No. 4-11** on the reply card.

Recordak Microfilm Reader

Transcribing information from microfilm records is easier with ambidextrous controls on the new Medalist 16mm film reader announced by Recordak Corp. The film winding wheel may be placed on either side of the viewing screen. A new gate-like type of aperture is self loading. The film is simply pulled across the aperture and inserted in the take-up spool. When the film starts moving, the aperture gate automatically closes and grasps the edges of the film in V-shaped notches. These hold the film in focus at all times. The absence of glass guides practically eliminates dust scratches on the film images. The unit makes paper facsimile prints without the need of a dark room. The Recordak Rapid Facsimile Kit is used for this purpose. The screen of the Medalist reader is partially shielded from overhead lighting, preserving the natural image contrast. A choice of three magnifications—24, 32, or 40 diameters is available in the Medalist reader. The reader weighs about 60 lbs. and occupies a desk area of only 13½ by 24 inches. For full details write Recordak Corp., 415 Madison Ave., New York 17, N. Y., or circle **No. 4-12** on the reply card.

Aluminum Sheet Highway Signs



This Increment Sheet Sign is in-place on Garden State Parkway in N. J.

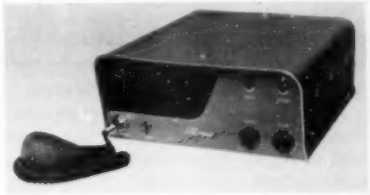
A new type all-aluminum sheet highway sign has been developed especially for the large signs required on the major expressways and interstate highways. The new sign is designed to withstand winds in excess of 100 mph and utilize readily available aluminum sheets and structural members. Called the Increment Sheet Sign, this simplified functional structure can be fabricated in any required size. Each sheet engages and butts firmly together with adjacent sheets forming a smooth sign panel without projections on the sign face. Ground signs of the new design are supported on round tapered aluminum posts secured to footings by anchor bolts. Overhead signs are supported on tubular aluminum structures. More information from Traffic and Street Sign Co., Newark 5, N. J., or circle **No. 4-13** on the reply card.

700-Watt Mercury Luminaire

A new 700-watt luminaire that uses either clear or color-improved mercury lamps, offers increased lamp economy, and provides a high level of uniform illumination, is now available from General Electric. Although designed primarily for application on whiteways, the luminaire may also be used in lighting parking lots and other areas where a high level of illumination is required. The extended lamp life makes the unit ideal for higher level highway installations where traffic is heaviest and replacement becomes a problem. The luminaire features a one-piece combination reflector-housing, a heat-resistant borosilicate glass refractor and a new slipfitter mounting. An access door in the slipfitter mounting arm facilitates internal wiring and provides space for integral mounting of a photo-electric control cell. More information from General Electric Co., Schenectady 5, N. Y., or circle **No. 4-14** on the reply card.

Mobile Radiotelephone

A FM mobile radiotelephone that can be used for communicating between vehicles and fixed points, from one vehicle to another and betwen two or more fixed points, is available from Kaar Engineering Corp. The Kaar TR500 is operable in the 450-460 megacycle special and safety services and the 460-470 megacycle radio bands. Under average conditions the unit will provide reliable communication between vehicles and a fixed point within a 10-mile radius of the fixed station. Ranges of up to 50-200 miles can be obtained between vehicles and from fixed points to vehicles when a repeater station is used, the range depending upon the effective elevation of the repeater station and the character of the terrain. It is available as a complete single package unit, suitable for mounting under the dash of a vehicle; on any flat surface; or as a system containing the transmitter, receiver and power supply in one unit for the trunk of



Unit is available as complete single package set for reliable communication

an automobile, with a separate control head and speaker for mounting under the dash. In either case it may be operated directly from a 12-volt battery or 110 volts AC (house current) and may be used interchangeably as a mobile unit or base station. For further details write Kaar Engineering Corp., 2995 Middlefield Road, Palo Alto, Calif., or circle **No. 4-15** on the reply card.

Rotary Broom Cores Without Filler Materials

Broom cores are now furnished without filling material by the Van Brush Mfg. Co. for those who want to fill their own. Now over 15 popular makes of rotary sweeper broom cores are manufactured by Van Brush. Van Brush can furnish bristles of Indian Palmyra stalks, African Calabar Bass or Hickory Fibres. Also flat spring steel wires are available. More information from the Van Brush Mfg. Co., 327 Southwest Blvd., Kansas City, Mo., or circle **No. 4-16** on the reply card.

No need to move truck when you want to dig a hole across a ditch or over a fence

Pitman Unit Lifts, Digs and Transports

Availability of a new multi-purpose piece of equipment designed especially for maintenance work has been announced by Pitman Mfg. Co. It is the Pitman Hydra-Lift, Model 60HB, equipped with a hydraulic digger attachment that offers in a single, self-contained unit, a piece of equipment that can lift loads of all kinds, dig a hole, also transport men, tools and materials to and from a job. It handles augers with diameters up to 24 ins. and can dig a hole at any point within a 180°, 26-ft. radius of the truck. Complete details from Pitman Mfg. Co., 300 W. 79th Terrace, Kansas City, Mo., or circle **No. 4-17** on the reply card.

New Refuse Container System

A new refuse container system designed to reduce collection time and costs at 'big stops' on commercial refuse collection routes has been announced by Gar Wood. The new system employs a design which allows a loaded Gar Wood Pax-All container to be rolled up to a Gar Wood Load-Packer, snapped on to the tailgate, and hydraulically raised and emptied into the Load-Packer's hopper. The entire operation is handled by one man who raises, empties and then lowers the container with a single lever. Each container has 1-cubic yard capacity, is leak, odor and rodent-proof, and has a split-cover which allows it to be easily opened and loaded without having to raise the entire cover. The hydraulic lifting and lowering of the Pax-All container is completely independent of the Load-Packer's own packing cycle. The hopper can be cleared even while the container is being lowered. For more details write Gar Wood Industries, Inc., Wayne, Mich., or circle **No. 4-18** on the reply card.

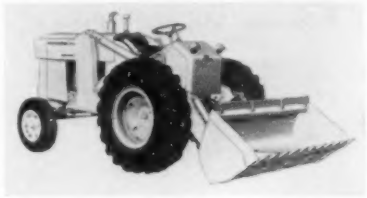
One man is needed for entire operation

Air Placement of Structural Concrete

A new method of air placement of structural concrete is announced by Air Placement Equipment Co. The new Airplaco Concrete Placers are available in two models: CP-10 which handles 10 cu. ft. of concrete per charge and CP-15 handling 15 cu. ft. per charge. Either 4 or 6-in. tubing is available for use with both models. Tubing size to be used will depend upon rock size to be handled, production rate required and amount of air available. These units will place concrete with 2 to 6-in. slump; they will also place the more harsh aggregates, such as Haydite. Production rates will range from 8 to 20 cu. yards per hour. With the Concrete Placer, concrete is discharged from either a standard discharge box or from special discharge sections designed to fit narrow forms. The discharge box is easily moved about on the job to distribute concrete where it is needed. Additional information and specifications are available from Air Placement Equipment Co., 1009 West 24th St., Kansas City, Mo., or by circling **No. 4-19** on the reply card.

Multi-Purpose Tractor Loader

This tractor-loader can be converted into eight different machines easily and quickly—on the job, if necessary—from a loader to a street sweeper; to a backhoe with its own backfill blade; to a fork lift; to an angle dozer; then to a crane; a rotary broom; then back to a loader with a scarifier attachment. Operating the Work Bull 1001, the user can change directions instantly without shifting and speed as well, by switching from one foot pedal to the other. Hydraulically-actuated reversing clutches are controlled by a combination accelerator-directional foot pedal. Its standard bucket has a 75-in. width with a ⅞-cu. yd. payload capacity. The street sweeper attachment has a 63-in. broom with a ¾-cu. yard dust pan. As a rotary broom, it sweeps a 96-in. swath with a 30° hydraulic control left and right. The unit with a Davis 210 backhoe has its own backfill blade and with a swinging crane, the 1001 has a 2,000-lb. capacity. For more details write Massey-Ferguson Industrial Div., 1009 South West St., Wichita, Kans., or circle **No. 4-20** on the reply card.



Unit can be converted into 8 machines

Rotary Cutter For Roadside Maintenance

Five-ft. lift or trail type rotary cutters for highway and airport mowing are available from B-M-B Co. They require only 30 minutes to assemble and are simple to operate. They fit almost any make of tractor and units have full length skid shoes. For further details write B-M-B Co., Inc., 319-21 New York Ave., Holton, Kans., or circle **No. 4-21** on the reply card.

Cutter being pulled by a Ford tractor

Paver does both large and small jobs

Self-Propelled Black Top Paver

The Trac-Paver available from the Trac-Machinery Corp. is a self-propelled black top paver that handles both large and small jobs. It has an adjustable width hopper that extends to 10 ft. and closes to 8 ft. for narrow places. A strip paving attachment that permits the unit to channel bituminous concrete paving material in a strip from 3 to 11 ft. wide and lays any thickness from ½ to 5 ins. is also available. Paving speed of 5 to 60-ft. per min. or more is controlled by a hydraulic speed control valve. The screed is adjustable to provide up to 1½-in. crown in center, if desired. For full details write Trac-Machinery Corp., Nunda, N. Y., or circle **No. 4-22** on the reply card.

Office Work Facilitated With Photo-Copying Machine

Machine copies any mark on any paper

The Hunter Cub is a machine expressly designed for the small and medium-size office with a moderate amount of copying work. Using a true photographic process, the Cub copies any mark on any paper, regardless of color or writing medium. It is invaluable for quick (30 seconds) dry copies of blueprints, contracts, deeds and other documents, as well as plans, elevations and drawings. It is clean, as no chemicals come in contact with the operator. It takes paper up to 9 ins. wide, any length, and copies evenly from margin to margin. It is all metal and all electric. More data from Hunter Photo-Copyist, Inc., Syracuse, N.Y., or circle **No. 4-23** on the reply card.

Schramm Pneumatractor With Full Diesel Engine

A full diesel powered 125 Pneumatractor has been announced by Schramm. New features include a fuel pump of the distributor type, 12-volt starting equipment, using the principle of starting on gasoline, preheating the entire engine and then switching to full diesel; there is no need for extras, such as ether capsules, separate starting engines and glow plugs. Additional information is available from Schramm, Inc., 900 East Virginia Ave., West Chester, Pa., or circle **No. 4-24** on the reply card.

Easy-To-Use Waste Receptacle

A new waste receptacle, featuring an exclusive top with two full-width independently operating flaps for fast and safe waste disposal, has been introduced by Superior Metalware. The waste receptacle has been designed in three models for outdoor use on streets, playgrounds and parks. The receptacle has a rainproof top with independently swinging flaps. Additional information is available from Superior Metalware Division, John Wood Co., 509 Front Avenue, St. Paul, Minn., or circle **No. 4-25** on the reply card.

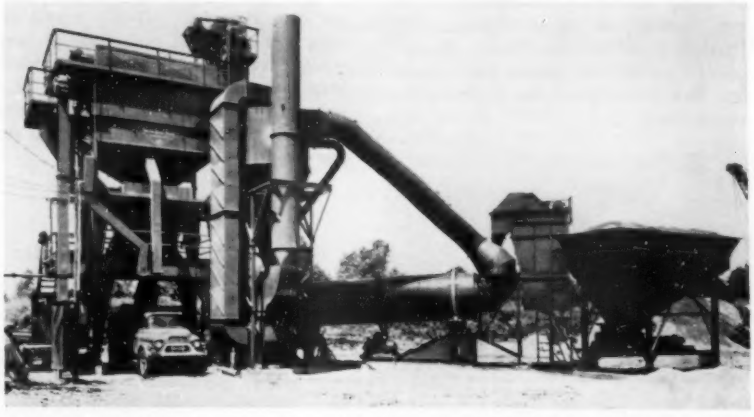
All Hydraulic Street Sweeper

The Saginaw-South Bend "400" all-hydraulic street sweeper has been announced by Municipal Supply Co. The sweeper features an open-flow hydraulic system that drives and controls all sweeping, loading and dumping mechanisms. The system provides for continuous operation with a minimum of maintenance. Constructed with a standard truck chassis, the sweeper can be quickly and easily serviced with standard replacement parts by automotive mechanics. It can travel at speeds up to 55 mph and sweep at speeds from 1.5 to 25 mph. The large, quick-dump hydraulic hopper holds 4 cu. yds. of dirt and refuse. Safety features include 4-wheel hydraulic brakes, covered cab and wraparound, shatterproof windshield. For full data write Municipal Supply Co., South Bend, Ind., or circle **No. 4-26** on the reply card.

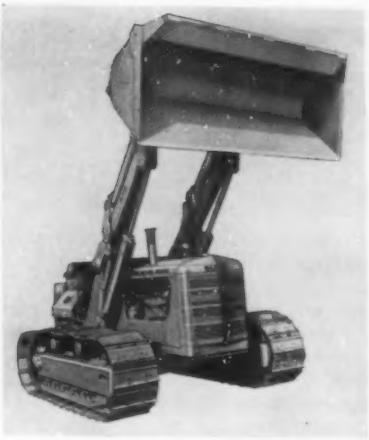
Pavement sweeper dumps from the rear and the hopper holds 4 yds. of refuse

Stationary and Semi-Portable Asphalt Plants

Greater versatility and increased economy of operation result from new design features incorporated in the semi-portable and stationary asphalt plants manufactured by Bollard Asphalt Plant Division. With the new design, mixers of 2, 2½ or 3-ton capacity can be installed in the same tower. Mixers of 1½-ton capacity are installed in a smaller tower unit. Only minor changes in mixer platform are required, whatever the mixer size. The plants, in sizes of 60 to 180 tph, are designed to individual requirements. For additional information write Bollard Asphalt Plant Div., The Colonial Iron Works Co., 17643 St. Clair Ave., Cleveland 10, O., or circle **No. 4-27** on the reply card.



Complete 120 tph semi-automatic asphalt plant made by Bollard Asphalt Plant Div.



Maintenance and construction departments can use the Oliver Model OC-156

Oliver Loader

A loader with a 2¼-yd. bucket capacity has been announced by The Oliver Corp. Called the OC-156, it is a completely integrated unit, with the loader matched to the full capabilities of the 110-hp tractor. The unit is rigidly mounted so that the loads are taken directly on the subframe, and the new, low-profile design provides fullest visibility and a low center of gravity for quicker, fuller loading. More information from The Oliver Corp., Industrial Division, 19300 Euclid Ave., Cleveland 17, Ohio, or circle **No. 4-28** on the reply card.

Ditcher-Terracing Blade

Designed specifically for use with 3-pt. lift tractors having 20 to 28-hp drawbar rating, the Servis ditcher-terracing blade has the advantage of 3-way positioning for best operation. Extended blade can be easily projected 24 ins. to right or left of rear tires, by pulling one pin. This blade is ideal for terracing, digging and cleaning ditches, backfilling, roadway work and snow removal. For further details write Servis Equipment Co., 1000 Singleton Blvd., Dallas, Texas, or circle **No. 4-29** on the reply card.

Servis ditcher blades are most useful for levelling dirt roads and driveways

Allis-Chalmers Diesel Power Units

Two new diesel power units have been added to the Allis-Chalmers' engine line. They are the 88-hp Model D-344, and the 131-hp Model D-516 units. Both engines are designed to serve a wide range of power requirements in the construction field, for crusher plants, for generator sets, and in other work where heavy-duty general utility power units are adaptable. The engines provide a steady hp output at practical working speeds from 1000 to 1800 rpm. The D-344 is a 4-cylinder and the D-516 a 6-cylinder engine. Both units are available in either closed or open type models. For further details write Allis-Chalmers Mfg. Co., Tractor Group, Milwaukee, Wis., or circle **No. 4-30** on the reply card.

Barricade Signs

Barricade signs with separate paneled copy are available from Miro-Flex. The message is changed to meet whatever the situation calls for by inserting standard panels in

Signs are furnished by Miro-Flex Co.

the proper sequence. The copy and border are embossed and reflectorized with a white beaded background. The backs of the panels are also reflectorized with black and white diagonal marking. For more information write Miro-Flex Co. Inc., 1824 East Second, Wichita, Kans., or circle **No. 4-31** on the reply card.

• • •

Placement Service for Better Sewage Plant Operation

The Florida Water & Sewage Works Operators Association has established a placement service to aid interested personnel in securing positions and cities in filling positions. Mac Grossman, 369 Granello Ave., Coral Gables, Fla., is director. No charge is made to either party. Information by cities seeking operators should include: Type of plant; plant size and community population; number of lift stations; operating budget; outline of duties; number of personnel under the operator; certificate required; age requirements; civil service; and salary.

How To Interest Young People in Civil Engineering

Prepared by the Committee on Engineering Education, ASCE, a bulletin purposely directed to students of grade school and junior high school age is intended to stimulate interest in civil engineering as a career for those who have proper natural qualifications. If these aims are accomplished, the youngster will be able to plan his high school curriculum to provide a suitable foundation for an engineering education. Copies are available from ASCE, 33 West 39th St., New York 18, N. Y.

Research Assistantships in Sanitary Engineering

The State College of Washington has several half-time research assistantships available for persons interested in studying for the master's degree in sanitary engineering. For information, write to E. B. Moore, Chairman, Department of Civil Engineering, State College of Washington, Pullman, Washington.

Air Force Needs Sanitary and Industrial Hygiene Engineers

The Air Force will have vacancy requirements within the specialty field of Sanitary and Industrial Hygiene Engineering during fiscal year 1959 (July 1958-June 1959). Minimum qualifications require that the applicant have at least a baccalaureate degree from an accredited college or university in sanitary, civil, chemical or industrial hygiene engineering and be less than age 34 at time of appointment.

Those applicants who are less than age 28 will be considered for appointment in the grade of Second Lieutenant. Individuals age 28 but less than 34 will be considered for appointment in the grade of First Lieutenant. Applicants who are 28 but less than 34 must present evidence of a minimum of three years full-time experience in employment, of increasing responsibility, pertinent to the specialty of Sanitary or Industrial Hygiene Engineering. First

and Second Lieutenants of Air Force Reserve components, not on extended active duty, may also apply for recall to extended active duty under this program provided they are qualified as Sanitary and Industrial Hygiene Engineers and are less than age 34 on the effective date of return to active duty.

Details about the program may be obtained by writing directly to the Chief, Medical Liaison and Selection Division, Directorate of Staffing and Education, Office of the Surgeon General, USAF, Washington 25, D.C.

• • •

Seventh Southern Municipal & Industrial Waste Conference

To insure adequate housing and dining facilities, the Southern Municipal & Industrial Waste Conference, originally scheduled for March 27 and 28, has been postponed to May 1 and 2. Prof. J. W. Williams, Civil Engineering Dept., Duke University, Durham, N. C., will provide additional information.

NEWS OF ENGINEERS

LAWRENCE M. MADDEN, former Sup't. of Public Works of Estherville, Ia., has been appointed Acting Chief Officer of the Public Utility Agency for the government of Guam. For the past 15 months, Mr. Madden has been Deputy Director of Public Works in Guam. The Public Utility Agency includes the electric, water and telephone systems.

ROBERT H. HARMESON, formerly with the University of California, and the AEC at Los Alamos, succeeds Dr. Max Suter as head of the Peoria Research Laboratory of the Illinois State Water Survey. Dr. Suter is principal engineer on the study of ground water conditions in Northeastern Illinois.

STANLEY ENGINEERING CO., Muscatine, Ia., has been retained as consulting engineer by Owatonna, Minn., for improvements to the water supply system.

EDWARD S. HOPKINS, consulting sanitary engineer, has a new address: 410 Professional Bldg., 230 North Charles Street, Baltimore, Maryland.

This compact Jaeger Model 2PN, pumps all the water a 2" suction hose can handle. **With 2½" suction hose it pumps more than 14,000 gph.**

Now handle more water with Jaeger pumps

Today's Jaeger Sure Prime pumps deliver performance never before offered—and at slower, long-life operating speeds. For example, a Jaeger 6PH can handle 100,000 gph as a dewatering pump or deliver 975 gpm at 60 psi pressure for well point jetting or gravel washing. Base your pump buying on latest information. See your Jaeger distributor or send for catalog.

THE JAEGER MACHINE CO., 400 Dublin Avenue, Columbus 16, Ohio

AIR COMPRESSORS • MIXERS • PAVING SPREADERS and FINISHERS

When measuring through the discharge end of a submerged throat or conduit, DEPEND ON . . .

Sparling
WATER WORKS INTAKE METERS

Sparling Water Works Intake Meters are designed to provide efficient and economical service. Ideal for a large volume of water flowing through the discharge end of a submerged throat or conduit. The very simplicity and variety of models available permit wide application . . . often using the existing headwalls or supports. Propellers may be plastic or stainless depending upon installation and use. Maintenance is simple. Available with Sparling's new Indicator-Totalizer 245. Drop pipes can be any length. Ideal for use in telemetering systems.

10" to 72".

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Yes! ☐ We are interested in increasing our metering efficiency. Send us more information . . . no obligation, of course.
☐ Also send information on Sparling's line of Water Control Equipment.

Name .....
Company .....
Address .....
City ..... Zone.... State .....
Send to: SPARLING METER COMPANY
227 N. Temple City Blvd.
El Monte, California

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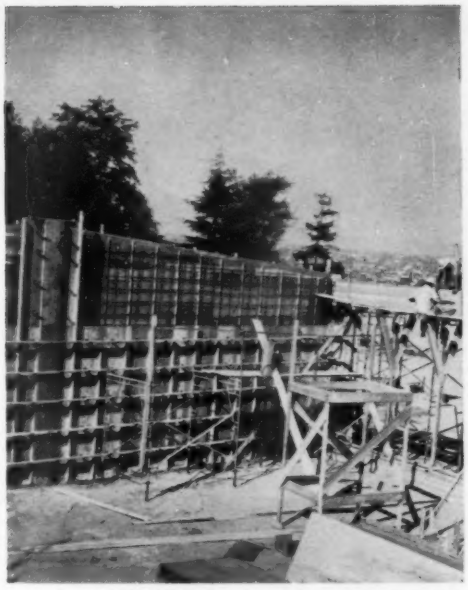
Kansas City 15, Mo., 4117 West 67th
C. H. Stockwell

As spring weather melts the big drifts we can look with less distress at this evidence of last winter's record snowstorms. Heavy equipment was called out to open many blizzard-bound roads. Here a Caterpillar No. 955 Traxcavator, owned by the town of Carlisle, N. Y., clears a township road. Drifts 15 ft. deep marooned some farms for two weeks.

—Worth Seeing



20 percent faster forming is the claim for this Trueform system for concrete poured at the Army Reserve Training Center at Fort Lawton in Seattle. Over 40,000 square feet of fir plywood was used for the job, and the contractor reports with pride that alinement of finished walls was as good or better than with previous form techniques.

Sixty grizzly bears regarded a former open garbage dump in Yellowstone National Park as their own private lunch counter, and objected when the spot was converted into a modern sanitary landfill. At times the operator of the International Drott TD-9 Skid Shovel had to put his tractor into high gear and take refuge in a screened enclosure. The solution: Let the bears eat their fill and then compact and cover up the remains.

Thirty-inch Robinson clay pipe with Slip-Joint factory-cast joints is teamed with a network of smaller diameter clay pipe lines to complete a system for handling corrosive industrial wastes at the Parlin, N. J., plant of Hercules Powder Co. Wastes are neutralized on plant premises.

Grading the way for a new community. The rapidly expanding Port Charlotte home development just north of Punta Gorda, Florida, had three Huber-Warco 5D-190 motor graders working on the job site. Here marl content subbase is being spread for an access road. It is estimated that the area will cover some 150 square miles upon completion.

FEIN Portable Automatic Pipe Saw Cutting 30" Pipe

Here's What a Fein Can do For You...

- Produce a Perfect Milling Cut
- Cut 1" of Pipe Dia. Per Minute
- Operate In Or Out of Trench
- Set Up In 5-10 Minutes
- Requires Only 12" Clearance
- Operates Under Water
- Cuts 6" To 60" Pipe

It Will Pay For Itself . . . In Time And Labor Saved

Details and Prices Upon Request

PRESCOTT TOOL CO., INC.

BOX 7 - GREENDALE BRANCH
WORCESTER 6, MASS.
Tel. West Boylston TEmple 5-4431

by Arthur K. Akers

★ DAVID D. ACKERMAN is new president of the Ludlow Valve Mfg. Co., Troy, N. Y., succeeding Earl W. Pughe, retired. Strengthened manufacturing facilities are announced at the same time.

Mr. Ackerman

Mr. Kurtz

★ JAMES E. KURTZ comes to Pacific Flush-Tank Co., Chicago, as advertising manager.

★ AMERICAN WATER SOFTENER CO., Philadelphia, water conditioners, launches a "vigorous program of development" with these elections: Alfred G. Scattergood, president; Alfred G. Ziegler, vice president and general manager; Martin H. Love, Jr., vice president; George S. Garrett, treasurer.

★ THE AMERICAN VITRIFIED PRODUCTS CO., Cleveland, acquires its fourteenth plant—Tulley Concrete Products Co., St. Louis. William E. Bussen becomes district manager there.

★ GALION IRON WORKS & MFG. CO. names Richard G. Smith district representative in Michigan, Indiana, Illinois and Wisconsin, with headquarters in Galion, Ohio.

★ W. J. KLEIN moves up to vice president and director of sales promotion, Tractor Group of Allis-Chalmers Mfg. Co. R. L. Smith is named manager of advertising for the three divisions in this group.

★ BOYD S. OBERLINK, vice president in charge of the Tractor Group, Allis-Chalmers, was elected president of CIMA at its annual meeting in Washington in January.

★ CHARLES J. BREX, Jr., keeps our presses hot with news of him! Last month we announced his appointment as assistant advertising manager, B-I-F Industries. This month we announce his elevation to advertising manager. Davol H. Meader moves up from advertising manager to assistant to George Kelsey, vice president.

★ KIMBALL BLANCHARD, formerly New York manager Ludlow-Rensselaer valves, moves to Neptune Meter Co., New York. He is also secretary-treasurer of New York section, AWWA.

Mr. Blanchard

Mr. Phillips

★ RECORDAK CORPORATION, subsidiary of Eastman Kodak, promotes Van B. Phillips from assistant to general sales manager, New York.

★ PRECISION CHEMICAL PUMP CORP., Waltham, Mass., a New England "comer" in the field, appoints Harlan A. Bentzinger supervisor of engineering and production.

★ CLEVELAND TRENCHER CO. names Raymond E. Orton assistant general manager.

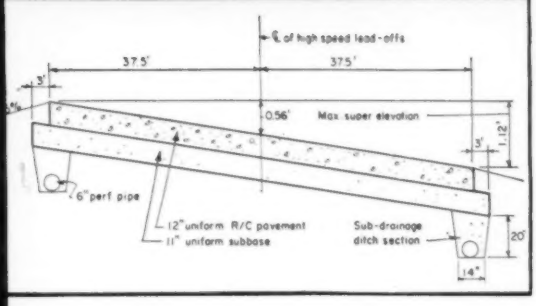
★ M. L. STUPPY succeeds F. O. Leopold as president of F. B. Leopold Co., water treatment equipment manufacturers, Zelienople, Pa. Mr. Leopold becomes chairman of the board.

★ SPARLING METER CO., El Monte, Calif., opens a Denver office, Howard Hatfield, manager.

★ IT IS REPORTED that dogs in Siberia are the fastest in the world. The trees are so far apart.

First High-Speed Runway Turn-Off

Weir Cook Municipal Airport, Indianapolis, Ind.
Engineers: Clyde E. Williams & Assoc., Inc., South Bend, Ind.
Contractor: Gast Construction Co., Warsaw, Ind.
Photo Above: in-construction view.
Below: new runway and related pavement.
Drawing: cross section through high-speed turn-off.



POZZOLITH* employed in paving to obtain unique combination of advantages

Banked turn-offs that allow planes to clear the main runway at speeds up to 63 mph, are a feature of Indianapolis airport's new field extension comprising 180,000 sq. yds. of concrete slab . . . with POZZOLITH.

Use of POZZOLITH provided the following unique combination of advantages:

1. ***Work Speeded Up*** **. . . because high 3-day strength permitted contractor's early use of adjacent paving.**
2. ***No "Downhill" Movement*** **on super depressed turn-offs . . . because mix having good workability was obtained with 1½" slump.**
3. ***Lower Cost-In-Place*** **concrete . . . because of savings in placing and finishing and because of higher strength resulting from low water content.**

Call in your Master Builders fieldman for full information on these and other advantages of POZZOLITH for *your* projects.

* **POZZOLITH—registered trademark of The Master Builders Company for its time-tested water-reducing, air-entraining admixture for concrete.**

THE MASTER BUILDERS CO.
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J. Pauli, Chief Engineer and W. Johnson, Chief Chemist of the St. Joseph, (Mo.) Water Company, discuss operation of their W&T V-notch chlorinators. The St. Joseph Water Co. is part of the American Water Works Service Co., Inc. system.

W&T V-notch Chlorinators— doubly accepted

The St. Joseph Water Co. found breakpoint chlorination the best way to treat Missouri River water. But this increased the range of chlorine requirements in the water treatment. W&T V-notch chlorinators were the answer.

W&T V-notch chlorinators have a chlorine feed range of 20 to 1 with an accuracy of 4%. Based on this acceptance at its St. Joseph plant, the American Water Works Service Co., Inc. has purchased V-notch equipment for use in other plants.

V-notch chlorinators are available to feed from 2½ to 8000 pounds of chlorine per 24 hrs. V-notch equipment also provides permanence and attractiveness through modern reinforced plastics. For comprehensive information about W&T V-notch chlorinators, write for Bulletin S-119.

WALLACE & TIERNAN INCORPORATED

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